POWER

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FRED R. LOW, *Editor*

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The Man-Power of the Power Plant

IN THE early 80's there were installed in the industries of the country some 1,225,000 horsepower of prime movers, mostly steam engines of the simpler sort.

This figure has increased to more than 39,000,000 horsepower and does not include the hundreds of thousands of horsepower of steam, electric, heating, ventilating and refrigerating plants installed in hotels, office buildings, stores and other establishments not in the industrial or factory class.

The development, through invention and consolidation, of gigantic industrial organizations, the phenomenal increase in the use of electricity for light and for the distribution of heat and power, the pumping, elevator, materials-handling and other services of the modern city building have resulted not only in this enormous increase in the aggregate power production of the country but also in a corresponding increase in the capacity and complexity of the individual plant.

The engineer of one of the most advanced plants of the 80's transplanted to a modern power station would be at almost as complete a loss as would the driver of a stage coach placed at the wheel of a modern automobile.

There has had to be, of course, a concurrent development of the personnel, the man-power behind the growing horsepower; a functional knowledge of, as well as manipulative skill to handle, this high-pressure, high-speed and highly complicated mechanism.

Only in recent years has the technical graduate found in power-plant engineering an attractive field for the application of his talent and training. Many of the most successful heads of power stations and departments are those who to their operative skill have added, by self-education, knowledge of the theory and fundamentals of the conversion of heat into power and an executive ability and appreciation of comparative values that fits them to deal with the larger responsibilities of the modern job.

POWER *Stands for . . .*

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application

Output, Power And the Worker

TWENTY years of progress in the use of power by American industry show great gains. These are so closely parallel to the increase in the country's prosperity that one cannot be far wrong in concluding that there is some connection.

Federal census figures for 1909 show that at that time industry in the United States was equipped with 2.8 horsepower per worker. In 1927, the last year for which census figures are obtainable, 4.8 horsepower was available for each worker. By this time it is extremely probable that the figure has been increased to 5 horsepower. This means that each man in industry now has at his command nearly twice the power he could call on twenty years ago.

What has this meant in output? In 1909, the value of the product of each man in industry was $3,125. Now this figure is around $8,000, it having been $7,479 in 1925, the last year for which figures have been made public. Of course, the dollar is today worth less than it was then, its purchasing power having decreased so that it now takes something over one and a half dollars to buy as much as one dollar did. On this basis the output per worker has increased in actual value by about sixty-five per cent during the past twenty years, according to the census.

Compare the increase of slightly over seventy-five per cent in horsepower per worker with the above figure. The parallel is close—so close that it is obvious that the increase in output has largely resulted from the increase in industrial power. Of course, other factors have also influenced production growth. Consider, however, only the product of the industrial workman's labor. Given the power and improved machines capable of putting it to good use, little else is required to increase productivity, except a wage incentive. The machines may be considered merely as a means of making the power useful. Fundamentally, increase in the individual's output depends upon increase in the power that he is able to apply, while increase in his prosperity depends upon his output.

Forged Drums In Quantity

THUS far all the very high-pressure boilers in this country have employed drums forged from the solid ingot, this being necessitated by the wall thickness involved. These drums have been costly, not alone because of the process involved but also as each has been a special job. For medium pressures riveted drums are easily fabricated and are used because they are less expensive. However, many feel that the riveted drum invites caustic embrittlement, and they are therefore urging the adoption of welded drums. This situation was commented upon recently in these columns.

There is another possible solution to this problem that might bear looking into. If a few manufacturers with facilities for turning out forged drums were assured of sufficient orders they would probably be able, through quantity production, to keep the cost down to a figure comparable to riveted construction in the moderate-pressure range. Boilermakers not so equipped could purchase drums from these specialized manufacturers. This would go a long way toward removing the caustic hazard and at the same time satisfying those sceptical of welded drums. Discussion of this suggestion is invited.

Operate the Power Plant As a Business

THE power plant may be considered an industry within an industry, having all the items of expense of the major industry and rendering services required in the manufacturing processes. These services have a value that should be credited to the power plant's operation. If this were done more generally, managements would get a new perspective of their power plants. The power plant should be charged with every item of expense, capital, labor, fuel, management, just as is the manufacturing plant. Then it should be paid for its services at a rate commensurate with the conditions under which they are rendered. If both power and steam can be purchased, the rate allowed the plant should be based on the prevailing rates for like services from the utility.

When this is done, as in some instances, the power plant instead of being an item of expense in the operation of the business will in many cases become a source of revenue. Furthermore, when each manufacturing department is charged for power and steam at a definite rate, the department managers will become interested in keeping down these items of expense in the processes. Those who operate the power plant realizing that their department is being given full credit for the services it renders will have a real objective toward which to work. Knowing that they are in competition with other ways of supplying the same service, the power-house operators will try to meet this competition. Being operated as a business, brings to the power plant all the elements that work for the highest economy and the lowest production costs.

Twelve Hours Is Too Long For an Engineer to Work

SEVEN hours a day for five days a week is labor's new slogan. This must sound completely Utopian to the thousands of men now working on twelve- and thirteen-hour shifts in a large number of the power plants throughout this country.

It is not unusual to find clerks in rural stores on duty from sunup to sundown, probably a justifiable proceeding when business is slow at best. But wherever business has attained a sound foundation the hours of labor have shortened, until, in the more progressive industries, eight hours is the ruling shift.

Just why the engineer has not profited by this enlightenment of industry is difficult to explain. Certainly the trouble is not a lack of capital and profit existing in the industries being served by the power plants, for some of the larger mills are as mid-Victorian as any other industry in expecting the operating engineer to work on the two-shift seven-day work plan.

Too much is expected of these engineers. A man cannot remain keenly active and enthusiastic if he has no time for recreation. He will let things go unattended and maintenance will be ignored until major repairing becomes necessary. One cannot ask a great deal of a man whose energy is being expended merely in being on duty on long-hour shifts.

Some of the modern thinking so much talked about in certain circles should be centered on the power house, its personnel, and the hours of labor.

Value of Engineering Societies To Industrial Executives

AT MANY of the meetings of the engineering societies interested in power service problems there are presented papers, such as those dealing with the relation of industrial processes to power plant operation and design, that contain much of interest to the management of industrial plants. But only in rare instances is the industrial executive found supporting these societies by attending their meetings. Seldom does he afford his engineers the opportunity to attend as his representatives.

Recognizing the value of close attention to the experience of others as presented in society papers, the central station industry, on the other hand, encourages its engineers to attend society conventions. In many cases it is made part of the engineer's job, and the contingent expense is carried by the utility company.

Fall and winter meetings are not so far away, and plans for them are now being made. The industrial executive can profit if he will but follow the example of the central station men and attend or send a representative to the meetings of societies covering fields allied to that of his particular industry. Now is a good time to plan so that all of the important meetings will be attended.

The Engineer Versus The Architect

IN MANY cases the architect intrusted with the design of large buildings employs a consulting engineer to take over the responsibility of all of the mechanical equipment needed in the building. To him falls the task of designing the boiler and power plant, the heating and ventilating systems, and the other services.

The consulting engineer frequently discovers that his efforts toward producing what he considers a well-designed plant are hampered at the very start because inadequate space has been allotted for this equipment by the architect, who does not realize the importance of the mechanical parts of a building. In addition the engineer must be continually aggressive in order to prevent further inroads on his already inadequate space.

In view of the fact that the engineer is employed because of his greater mechanical knowledge, it is difficult to understand why architects so frequently disagree with and disregard his recommendations. It would seem to be the case that a little knowledge is worse than none. Either the architect should become more familiar with mechanical design or should accept the judgment of the engineer on the problems within his field.

In line with the trend in stationary practice, American applications of pulverized coal to the marine field have employed the direct-fired system whereas the British in their first all-pulverized-coal steamer, the "Swiftpool," have adopted the bin-and-storage system. One may now look for instructive and practical comparisons of the two systems as applied to the problems peculiar to marine service.

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London appears to be all "het up" over the discharge of sulphuric acid fumes from its power stations. Perhaps it is the high-sulphur coal used, or it may be that immunity to the smoke nuisance is responsible for this line of attack. At any rate, it provides another strong argument for processed coal.

* * * *

Reports from various industrial centers indicate that the engine and turbine people are now assuming the role of the aggressor and the utility that of the defender in the ever-waging contest between privately generated and purchased power.

* * * *

Last week the cylinder head blew off a high-pressure compressor in a macaroni factory in Brooklyn and "messed things up" in general. As usual, the boilers were blamed in the newspaper accounts.

* * * *

It is believed by government engineers that the rise in lake levels will have an important bearing on the coming negotiations with Canada regarding diversions from the Great Lakes watershed.

Oval—Two old Scotch marine boilers

Left and Right—New boiler room in which two boilers replace six

Below—Main turbine room, showing 1,000-kw. bleeder turbine at left, 200-kw. back-pressure unit (center) and 100-kw. motor-generator set (right)

New Garlock Power Plant to Repay Cost in 5 Years

AN INTERESTING example of power-service modernization, that promises to cut operating costs more than $50,000 yearly and to repay the entire installation cost in less than five years, is to be found in the plant of the Garlock Packing Company at Palmyra, N. Y. Two high-set stoker-fired water-tube boilers are doing the work of eight Scotch-marine boilers and are doing it more economically. Steam produced at 400 lb. and 150 deg. superheat makes possible the generation of byproduct power from large quantities of process steam. Corliss engines and direct current have been replaced by bleeder and back-pressure turbines and by alternating current.

It would be hard to picture a more striking contrast than that which exists between the new boiler room and the eight tank-like "Scotch marines" awaiting dismemberment in the old boiler room adjoining. Their passing will make available for manufacturing purposes more space than is taken up by the two new boilers (plus the third, for which a place is provided in the new boiler room).

The present plant, typical of the recent power trend in industry, particularly in rapidly expanding process industries, is best appreciated when viewed in the light of a brief historical sketch. About 30 years ago the first Garlock building on the present site was erected. New buildings were added from time to time as the business grew until the floor area reached its present total of 235,000 sq.ft. in eleven buildings.

Manufacturing power was electrified from the first, but, in accordance with the general practice of the time, 110-volt, direct-current motors were used exclusively. Steam for the Corliss-driven belted generating unit came from two Scotch boilers. Additions to this equipment were made from time to time until finally the plant found itself outfitted with eight of the Scotch boilers—the last one was installed ten years ago—and four Corliss engines.

Since steam at 50-lb. pressure was needed for process, and since the pressure of the marine boilers was necessarily low, it was obviously impracticable, with the old equipment, to use exhaust steam except for heating and a few low-pressure processes.

Between wasteful boilers and wasteful use of steam the total fuel consumption was high. Labor costs for hand firing, boiler maintenance, etc., were also abnormally high. Fuel consumption during off-load periods was but little less than during the periods of heavy load.

In the face of these losses that due to the use of low-voltage direct current might seem of minor importance. In 1924, however, when modernization was first seriously considered, it was decided to start by converting motor drives to alternating current. This made it possible to bridge over the transition period with purchased electricity and to prepare the manufacturing plant for the installation of modern alternating-current turbine-generators. The engines were gradually shut down as the direct-current load dwindled.

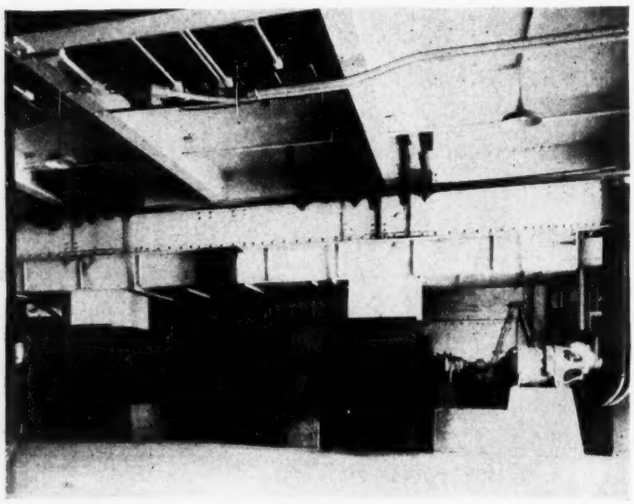
Power Landmarks—A distant view of the stacks and water tank of the Garlock Plant, Palmyra, N. Y.

Finally, in 1927, 75 per cent of the motors had been converted, and the time was deemed ripe to consider complete modernization of the power plant. Early in that year S. Firestone, of Rochester, N. Y., was called in as consulting engineer to report on the savings to be made by a thoroughly modern power installation. His estimates showed that such an installation would pay for itself in four or five years.

High Boiler Pressure and Bled Steam for Process

The plan presented, and later adopted, called for two 5,500-sq.ft. water-tube boilers, operating at 400 lb. pressure, one 1,000-kw. automatic bleeder turbine and one 200-kw. back-pressure turbine, mechanical coal- and ash-handling apparatus, and replacement of about 320 hp. of direct-current motors by 440-volt alternating-current motors, and installing a motor-generator set to handle the few remaining direct-current requirements. Departmental transformers were to be installed to reduce alternating current to 110 volts for lighting.

With these went the various necessary auxiliaries and such special power-service equipment as service pumps,



Forced draft for the new boilers is furnished by two 25,000-cu.ft.-per-min. fans

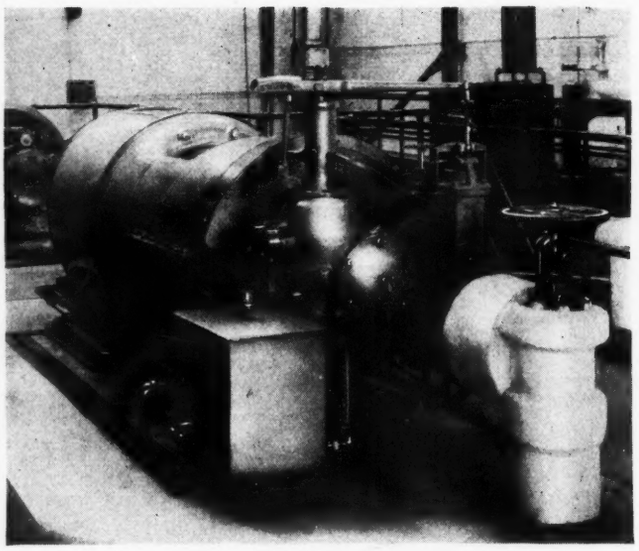
circulating pumps, air compressors, etc. An important part of the anticipated saving was in labor; it was shown that the use of stokers and of mechanical equipment for handling coal and ashes would cut the men from seven per shift to two, one fireman and one watch engineer.

Construction of the new plant was started in 1928 and completed early in 1929. The work was carried through without cutting off service for a single hour. This feat was particularly difficult, because the new turbine equipment had to be installed in the old engine room. While the boiler room was new, continued use was made of a large lime-and-soda hot-process softener bought for the old plant.

The principal equipment of the plant may be listed, briefly, as follows:

Two, 5,050-sq.ft., vertically baffled, horizontal water-tube boilers, delivering steam at 400 lb. pressure and 150 deg. superheat.

Underfeed stokers with clinker grinders, two-speed drives and four-speed motors.



The entire exhaust of this 200-kw. turbine goes to process and heating

Two 25,000-cu.ft.-per-min. forced-draft fans driven by wound-rotor motors.

One turbine-generator, 1,000 kw., at 80 per cent power factor, 60 cycle, 480 volt, 3 phase, bleeding at 50 lb. gage and exhausting to condenser at 2 in. abs.

One turbine, 200 kw., at 80 per cent power factor, 60 cycle, 480 volt, 3 phase, exhausting to process or heating at pressures ranging from 50 to 5 lb. gage.

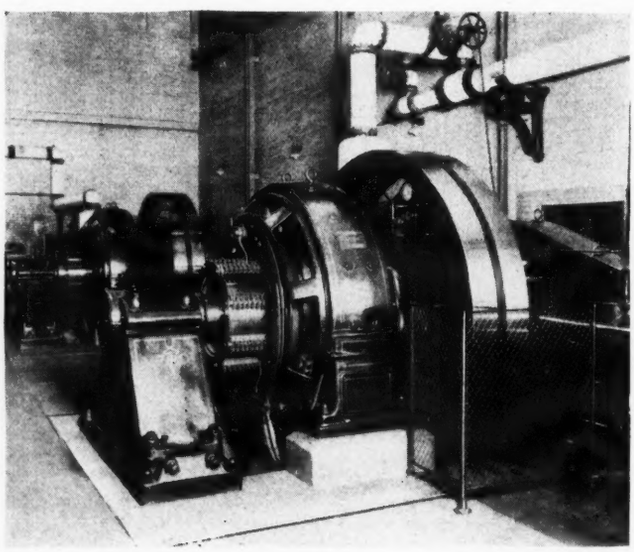
One motor-generator set, alternating-current motor, driving 100-kw., 125-volt, direct-current generator.

One 1,200-sq.ft. surface condenser with 300-gal. per min. centrifugal circulating pump, rotative dry vacuum pump and centrifugal condensate pump, all motor driven.

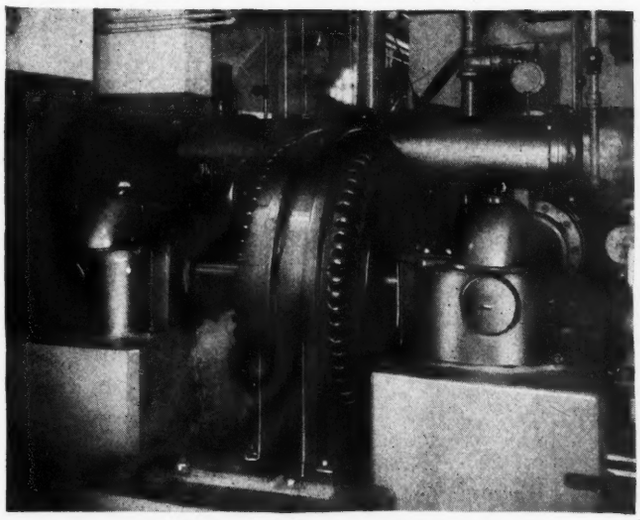
One centrifugal boiler feed pump, 6 stage, 100 gal. per min. at 210 deg., 440 lb. pressure, 1,750 r.p.m., driven by 60-hp. squirrel-cage motor.

One steam-driven outside-packed-plunger feed pump (spare) size 14 in. x 8 in. x 14 in.

One centrifugal house-service pump, 1,500 gal. per



Corliss-driven generators furnished direct current in the old plant



Synchronous motor-driven air compressor of 450 cu.ft.-per-min. free air capacity

min., 75 lb. pressure, and driven by a 100-hp. motor.

One centrifugal house-service pump, 750 gal. per min., 75 lb. pressure, driven by 50-hp. squirrel-cage motor.

Ash handling: Water-cooled gates; cars; bucket elevator; overhead hopper discharging to trucks.

Coal Handling: Hopper under tracks; reserve coal pile near tracks; scraper conveyors from hopper to crusher; from crusher by bucket and scraper conveyors to overhead bunkers (capacity four carloads).

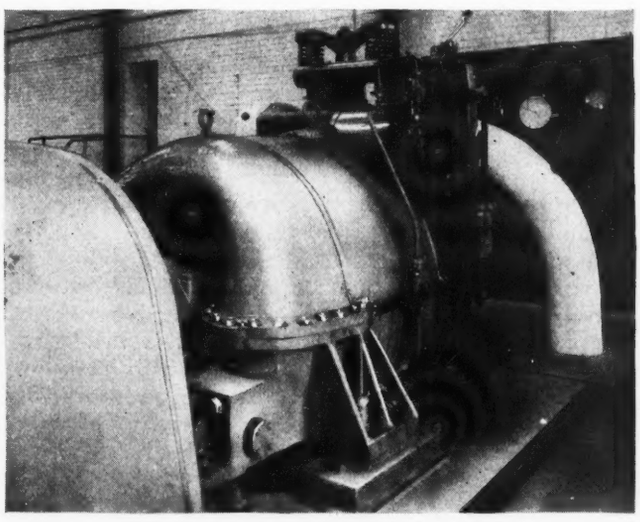
Chimney: Raised 25 ft. to 175 ft. (8 ft. 6 in. internal diameter at top).

Air compressor, one stage, 235 cu.ft. free air per min., 90-lb. pressure, driven by slip-ring motor.

Air compressor, two stage, 450 cu.ft. free air per min., 90-lb. pressure, driven by 75-hp. synchronous motor.

Instruments: Indicators for draft over the fire and in stack and wind-box pressure; 5 steam-flow meters; recorders for vacuum, steam temperature and CO_2.

Circulating water is now drawn from Red Creek, which runs between the plant and the main line tracks of the New York Central Railroad.



Turbine end of the 1,000-kw. turbine-generator bleeding steam to process

The expenditure on the new plant was $258,113, divided as follows:

Boiler setting and ash pockets	$13,100
Two boilers with superheaters	43,330
Pumps	5,657
Piping in connection with boilers	43,671
Stokers	21,015
Turbines and switchboards	49,130
Condenser	4,006
Ash-handling equipment	12,713
Coal handling	4,006
Extending chimney	2,890
Changing motors from D. C. to A. C.	7,677
Building changes	40,108
Electrical work in power houses	6,674
Taking down old switchboard	825
Covering pipes	1,618
Revamping boiler feed treatment	1,953
Furnishings	340
Total	$258,113

Cost of the boiler and accessories, including stokers, ash-handling equipment, etc., was $93.23 per 10 sq.ft. of heating surface. Turbines and switchboards cost $40.94 per kilowatt.

The new plant has not been running long enough for precise cost figures to be available. It is already evident, however, that the actual saving in operating costs will closely approximate that shown in the following analysis, prepared before the new plant was built:

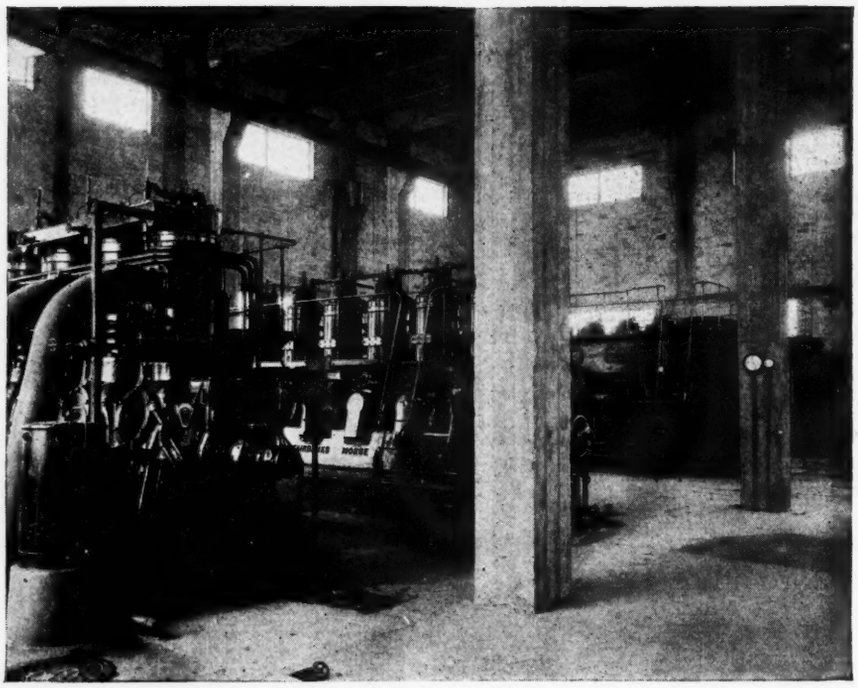
Feed-water test cabinet is installed in the well-lighted auxiliary basement of the turbine room

YEARLY OPERATING COSTS

	1927 (Actual	1929 (Estimated)
Labor	$18,924	$9,636
Repairs, direct expense, building expense	8,200	2,000
Coal	50,939	33,310
Supervision	1,578	1,578
Purchased power	18,272	.....
	$97,913	$46,524
Less estimated cost	46,524	.....
Saving in operating costs	$51,389	

Thus it appears that the saving in operating costs will pay for the new plant in about five years. Actually the saving should be more than that indicated, because the estimated steam and electric loads for 1929 are both substantially higher than for 1927.

This article has been prepared with the co-operation of C. R. Hubbard, vice-president and factory manager, and J. B. McClain, mechanical superintendent, of the Garlock Packing Company.



Municipal Diesel plant at Harlingen, Texas

DIESEL PLANT'S LOCATION *Depends Upon* LOCAL CONDITIONS

By L. A. Pease
Assistant Director of Engineering
Fairbanks, Morse & Company

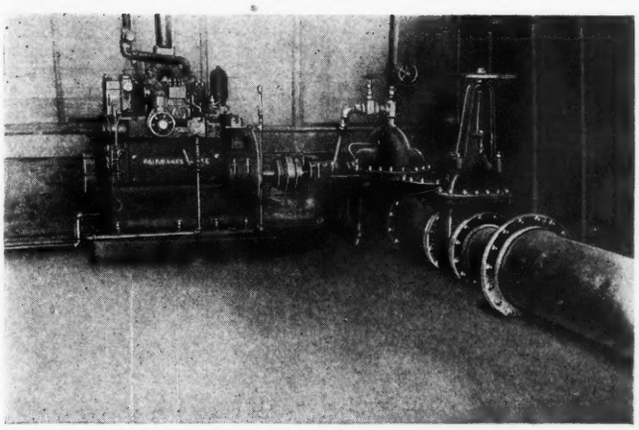
THE locating of a Diesel power plant should not be a hit-and-miss affair, any more than any other power plant. Unless all the local conditions are examined, the plant may eventually prove unsatisfactory.

In an ice plant or a pumping plant, for instance, where the driven unit is directly connected to the engine, it is necessary to place the engine adjacent to the driven load. A typical installation is shown in the plant of the Continental Ice Company, at Maybrook, N. Y., where a 3-cylinder 150-hp. Diesel engine is directly connected to a 225-r.p.m. horizontal ammonia compressor. This engine also carries a flywheel-type alternating-current generator, that supplies energy for the auxiliaries, making the plant entirely self contained. The distribution of energy through the switchboard permits the auxiliaries to be located any place in the plant where they best can drive their respective loads. The flywheel-type generator, in which the armature remains stationary within the bore of the field poles, permits a close coupling and an economic type of unit.

Another example where the drive definitely locates the unit is shown in the illustration of a 12-in. centrifugal pump in the Hammond Irrigation District's plant at Forsyth, Mont. This pump is driven by a 30-hp., 800-r.p.m. Diesel through a flexible coupling, thus fixing the entire unit in its relation to the pump. The pump itself is placed in the main water line, and its position was determined by the general layout. In this case, and also in the previous case, the power-plant building houses the driven unit.

In a Diesel central station supplying power for a considerable area it is not as much the load center that determines the location definitely as it is the bearing value of the soil and the available ground. The load center may be a considerable distance and constantly changing without detriment to the system.

In a case where the land adjacent to the load is valuable and is required for manufacturing purposes, it is possible to locate the plant at some distance from the load, provided the drive is electrical. The plant can be located where the value of the land is lower and where other factors are favorable.



A high-speed Diesel driving a vertical centrifugal pump

For the transportation of fuel it is only necessary to run a small pipe line from a railroad side track to the location of the plant. This can be almost any distance, as the amount of fuel used by a Diesel is comparatively small and can be pumped through small pipe lines at low expense. This, therefore, is not a controlling factor, and the nearness to a railroad track for construction or operating purposes is not essential.

On the other hand, a modern steam plant of the same capacity operating under the same conditions would require about three pounds of coal per kilowatt-hour, or a total of several thousand tons of coal per year. This tonnage would be expensive to handle were the plant far away from a switching track.

When locating a Diesel plant in residence districts, the local ordinances should be consulted, for in some cases a power plant is not permissible. But on account of the small amount of noise and almost entire absence of smoke a great many cities permit a Diesel plant to be erected in the vicinity of high-class residences, where steam plants are prohibited. The many installations of this class now in operation prove that power plants are not objectionable when they are operated properly, and if the exhaust stacks are silenced and of sufficient height to carry the gases beyond the immediate neighborhood. Lincoln Park, Chicago, an exclusive residence section, has a Diesel pumping plant which creates no objections.

The ground-bearing value, or the ability of the ground to sustain without movement the load that might be imposed by either engine foundation or the building foundation, is of great importance. The ground must be firm enough that no misalignment will occur and that no vibration will be transmitted to the surrounding buildings. The manufacturer of an engine always furnishes plans of the foundation based on soils of normal bearing value, such as clay and gravel. If, however, the soil is loose gravel, loom, quicksand or swamp, local authorities who are familiar with the ground-bearing value, should be consulted, so that if necessary steps can be taken to build larger foundations or to have piles driven and a firm fastening made before the foundation of the building and the Diesel units is begun.

In no case should an inexperienced contractor be permitted to erect a standard foundation on soil that is not firm. If he does the work, the engine unit or the building may settle to such an extent that the engine unit may be misaligned or the building will be destroyed, making necessary the complete rebuilding of the foundation.

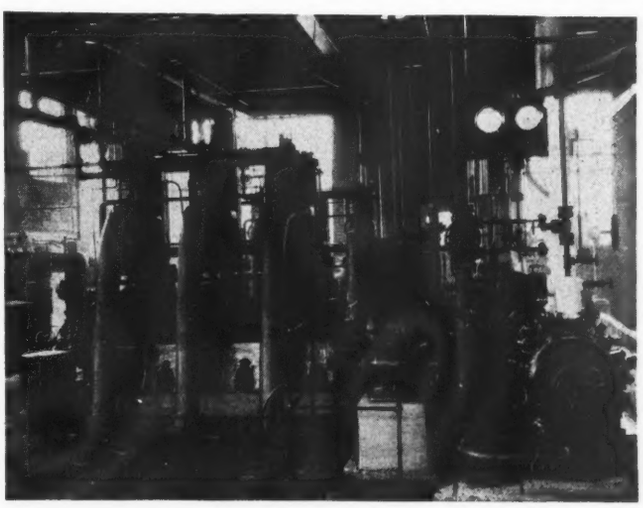
The cooling-water supply is not generally the major determining factor in the location of the plant, as it is nearly always possible to fill the cooling system with treated water and to get water in quantity and of a quality to make up the 2 to 3 per cent evaporation.

The amount of cooling water required for a Diesel cooling-tower system is not great, though it is a fact that every Diesel must have an adequate supply of cool soft water. This may, however, be easily secured from almost any water source by purifying a sufficient amount to fill the soft-water system, at most only a few thousand gallons. If the raw water is too turbid or contains an excessive amount of scale-forming ingredients, say 50 grains per gal. it would be preferable to have this raw water purified, or, possibly, filtered, if merely turbid. The supply of raw water for make-up need only be from 2 to 5 per cent of the amount of water circulated through the engine, depending upon the atmospheric conditions. The average evaporation is from 2 to 3 per cent, but 5 per cent may be required for such places as the desert region in the west. The amount of water pumped through a cooling system varies from about 10 to 30 gal. per brake horsepower-per hour.

THE LOCATION OF A DIESEL POWER PLANT MAINLY DEPENDS UPON

1. The type of drive employed and the proximity of the unit to the load center.
2. The cost or value of the land.
3. Local restrictive ordinances governing the installation of power plants.
4. The bearing value of the soil for foundations.
5. The available water supply for cooling water.
6. The proximity to railroad transportation.

A typical example of a Diesel plant located at a considerable distance from a water supply is the 1,900-hp. plant of the West Texas Utilities Company at McCamey, Texas. This plant consists of two 720-hp. and one 360-hp. units located in a town of about 2,500 people, in the center of a desert. The town has no local water supply and the raw water used to recool the distilled cooling water is shipped in from Alpine at the cost of $0.55 per barrel. The distilled water is obtained from San Angelo, a distance of 121 miles.

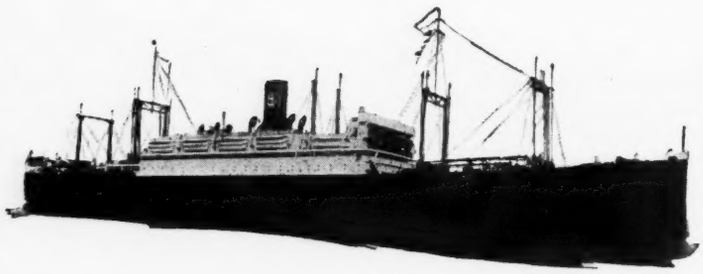


Diesel direct connected to an ice machine

On to Japan

Where the World Engineering Congress Meets

Ancient in BEAUTY



Modern in POWER

WHEN the steamship "President Jackson" drops anchor in the harbor of Yokohama on Oct. 28, a delegation of more than two hundred engineers will disembark for one of the most significant gatherings of a technical nature in history—the World Engineering Congress at Tokio. In a land where engineering advances came as revolution rather than evolution; where the effects of a tremendous national calamity were overcome by the combined efforts of engineering genius, and where an intermingling of the old and the new provides a vivid background, this international body will have a fit place to check the past, survey the present and to chart the future.

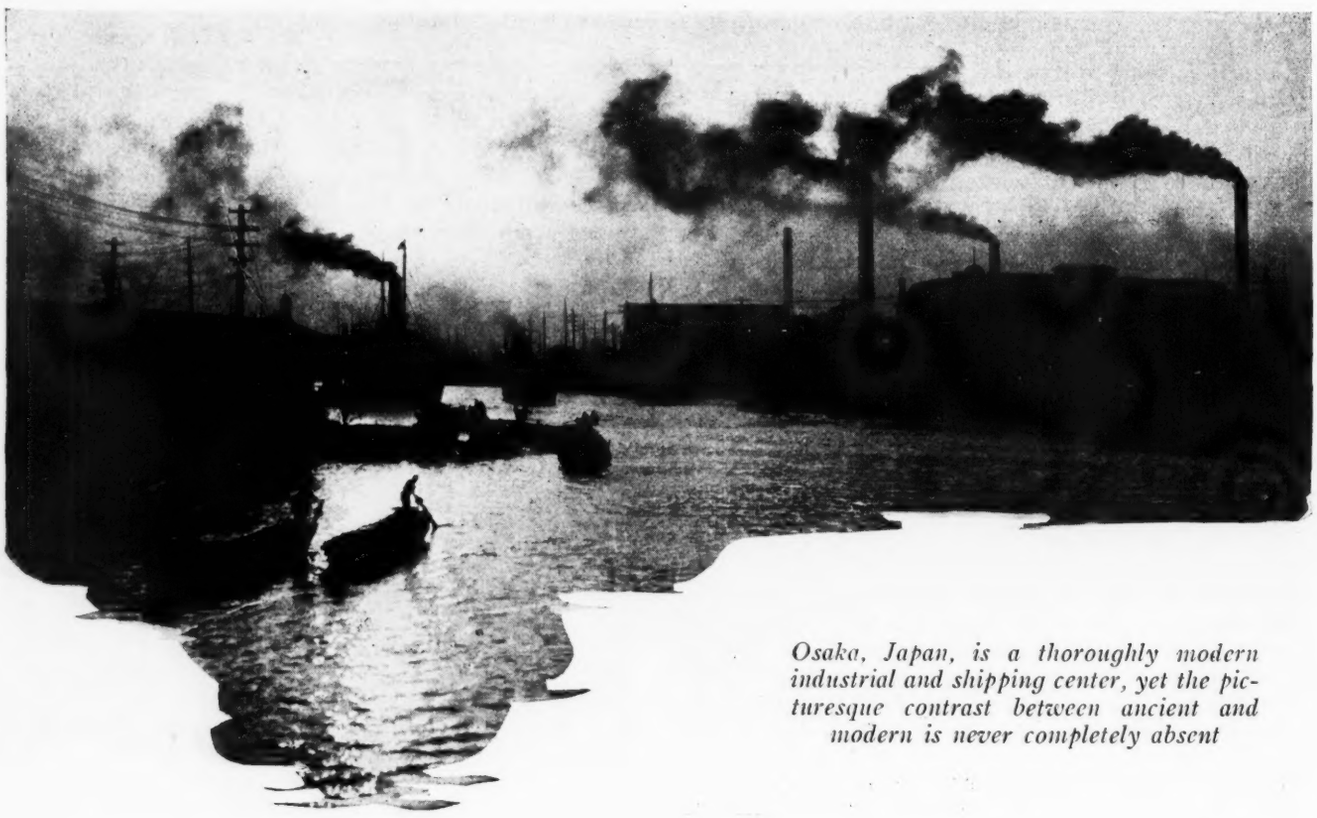
From Oct. 29, when the congress opens, to Nov. 7, when the closing ceremonies are scheduled, there will be sectional meetings, at which all phases of engineering achievement and endeavor will be discussed.

From Nov. 8 until Nov. 22 excursions to points of interest—places with such exotic sounding names as Yokosuka, Haranomachi and Inawashiro—will take place. There is much to see in Japan, and the splendor of Oriental scenery will compete with examples of industrial development for the interest of the group. Fujiyama and the turbines of the Denryoku K.K., the gardens of Tokio and the penstocks at Seto, the feudal castle at Nagoya and the first earthquake-proof subway—each will share the attention of the group.

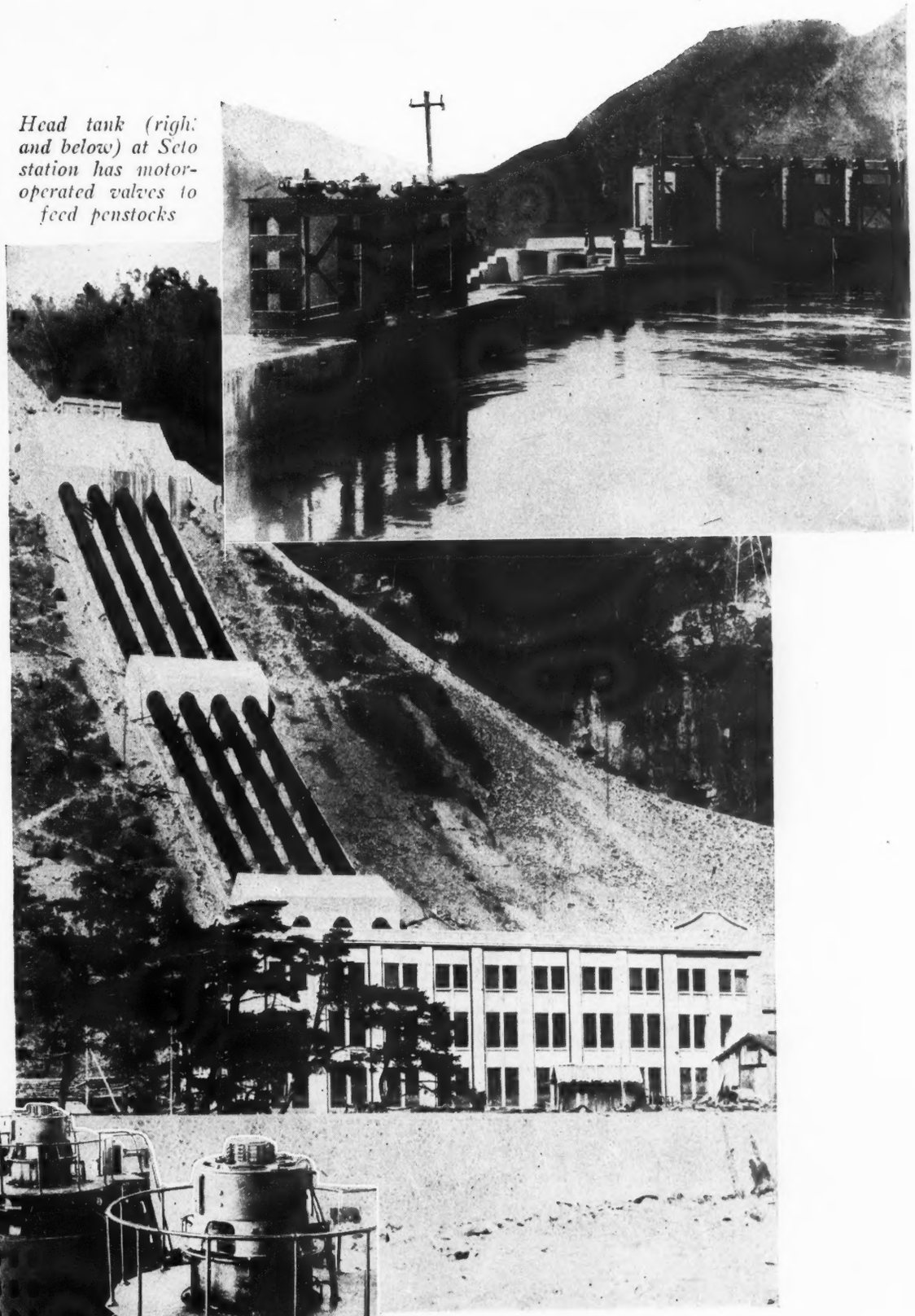
From Nov. 22 until Nov. 26, when the official steamer "President Taft" sets its course for San Francisco and home, there will be a chance for delegates to follow their own tastes and inclinations, traveling where they will through the land of the Mikado. On the homecoming trip there will be time for relaxation, time to revaluate the papers, and to recall the objects seen and places visited. Home once more, there will be memories technically valuable and generally pleasurable.

Two special trains will cross the United States carrying delegates to the chartered ship that steers for the Orient. They leave New York City Oct. 2 and 6; they leave Chicago Oct. 4 and 7.

On for Japan.

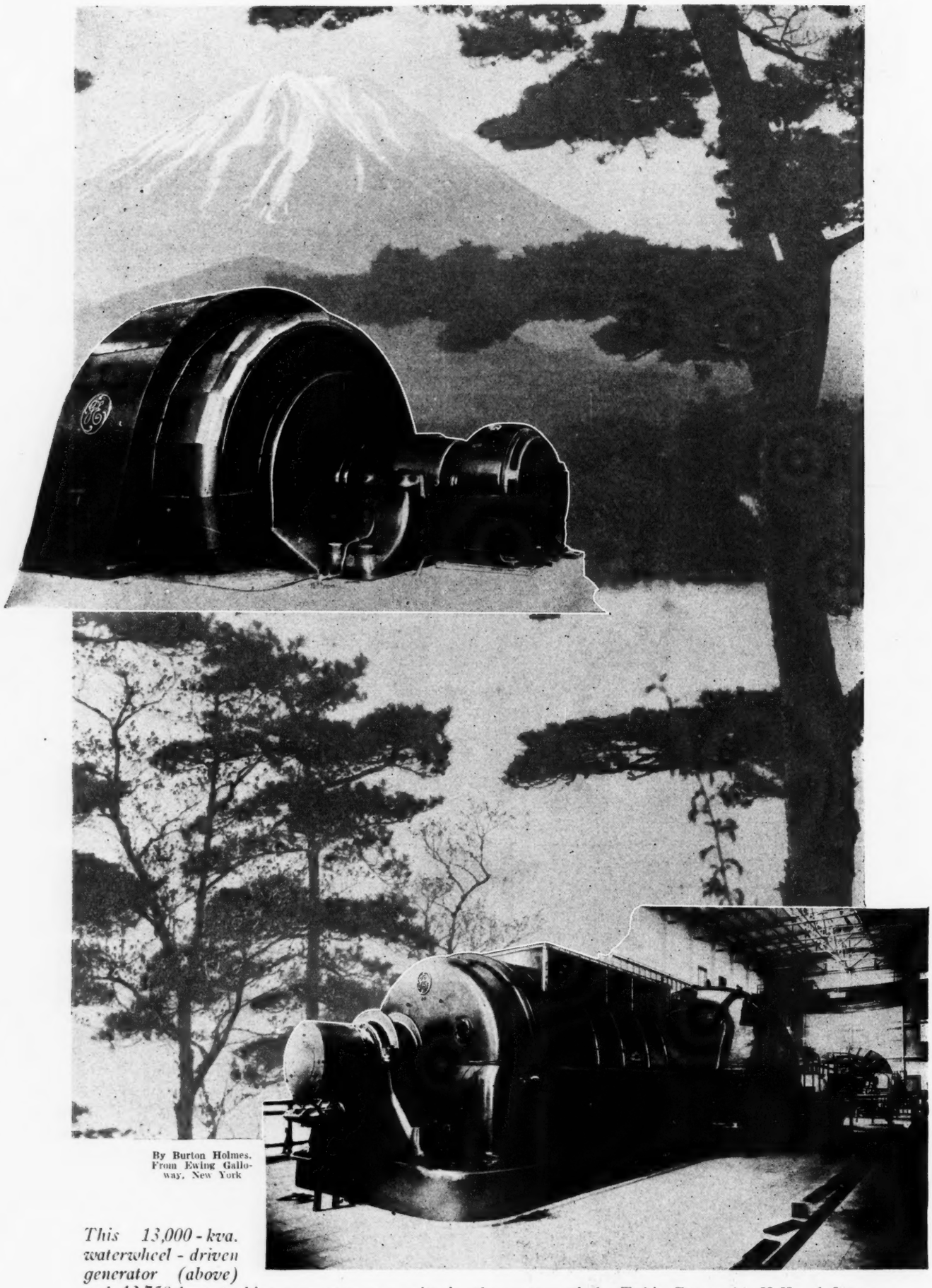


Osaka, Japan, is a thoroughly modern industrial and shipping center, yet the picturesque contrast between ancient and modern is never completely absent



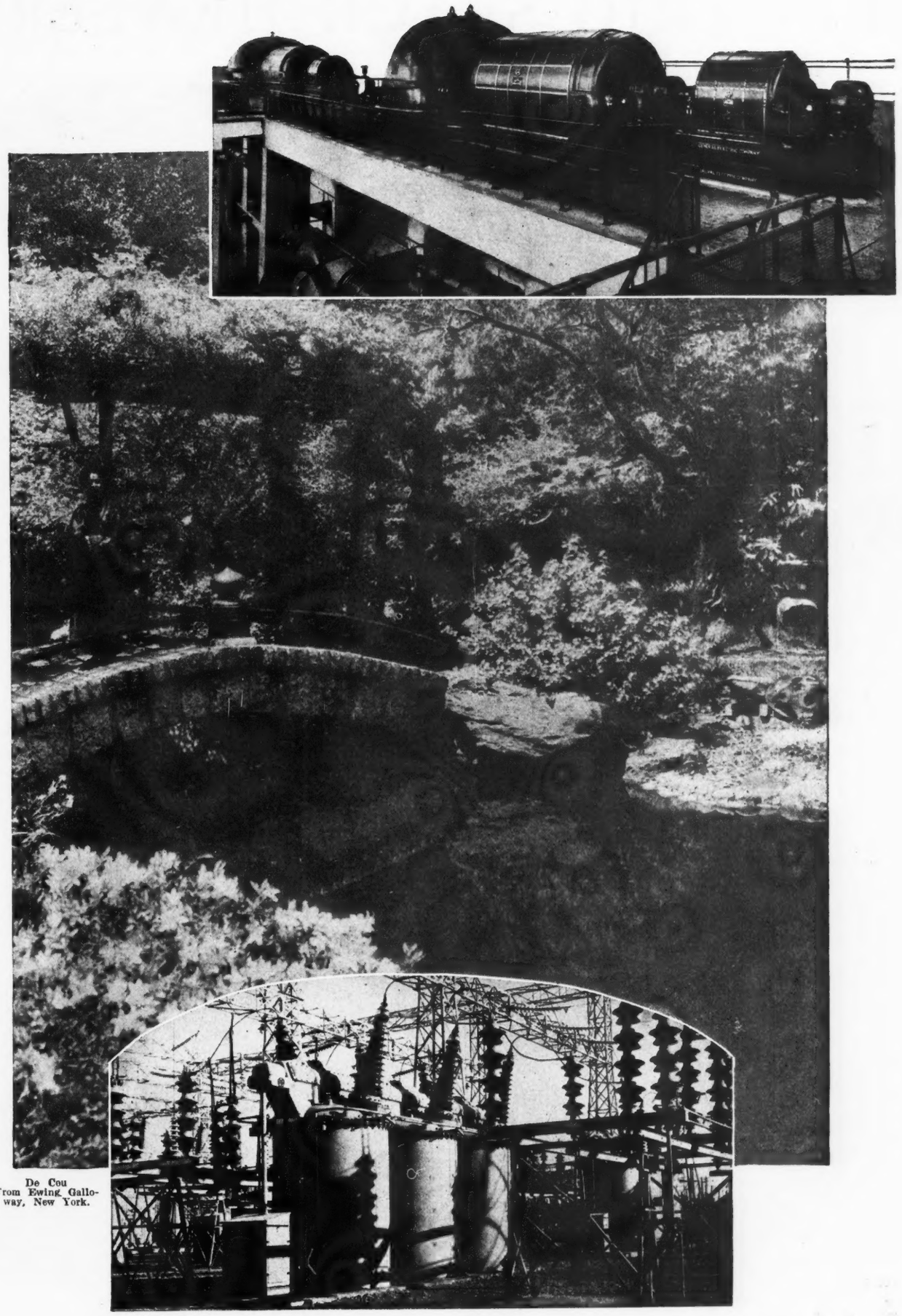
Head tank (right and below) at Seto station has motor-operated valves to feed penstocks

These four 7,500-kva. vertical generators are driven at 200 r.p.m. by reaction waterwheels with a 335-ft. head. The four steel penstocks supply water to these wheels at the Seto station of the Nippon Power Company



By Burton Holmes. From Ewing Galloway, New York

This 13,000-kva. waterwheel-driven generator (above) and 43,750-kva. turbine-generator are units in the system of the Tokio Denryoku K.K. of Japan Delegates at the World Engineering Congress will have opportunity to visit these and other modern installations



De Cou
From Ewing Galloway, New York.

Above—Two 30,000-kw. turbine-generators of the Ujigawa Electric Company at Osaka
Below—154,000-volt oil circuit breakers in the system of the Tokio Denryoku K.K.

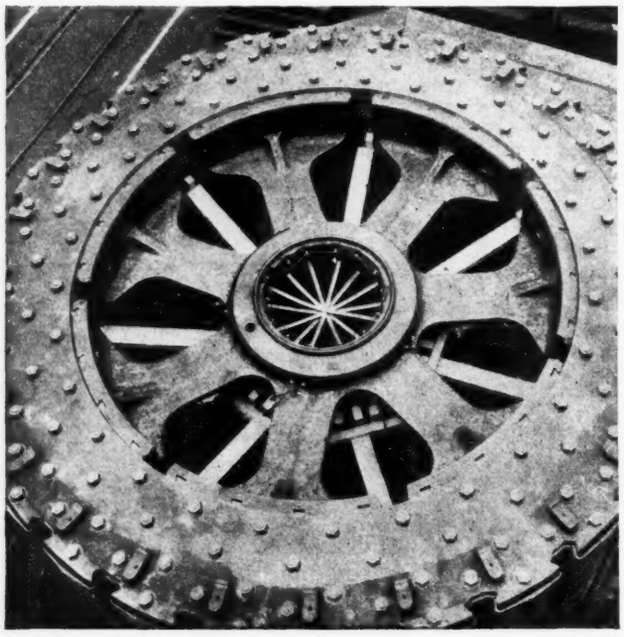
ELECTRIC SPACE HEATERS

Facilitate Shaft and Rotor Assembly

By R. M. Alspaugh
General Engineer
Westinghouse Electric & Manufacturing Company

With demand for larger electrical units have have come new problems of providing facilities for testing, transporting and assembling them. Because of size and weight limitations, machines are frequently shipped in parts and assembled at the place of installation. One of the most difficult and expensive operations encountered in the field has been the assembly of large rotors on their shafts. This operation involves either forcing the shaft into the rotor by pressure or expanding the bore of the rotor by heating and then inserting the shaft, or the application of both heat and pressure. The expense, uncertainty and danger involved in using a press to force the rotor on the shaft and the fact that a press of sufficient capacity is seldom available in the field make it advisable to expand the rotor's bore before placing it on the shaft.

Fig. 2—Rear view of rotor, showing position of space heaters



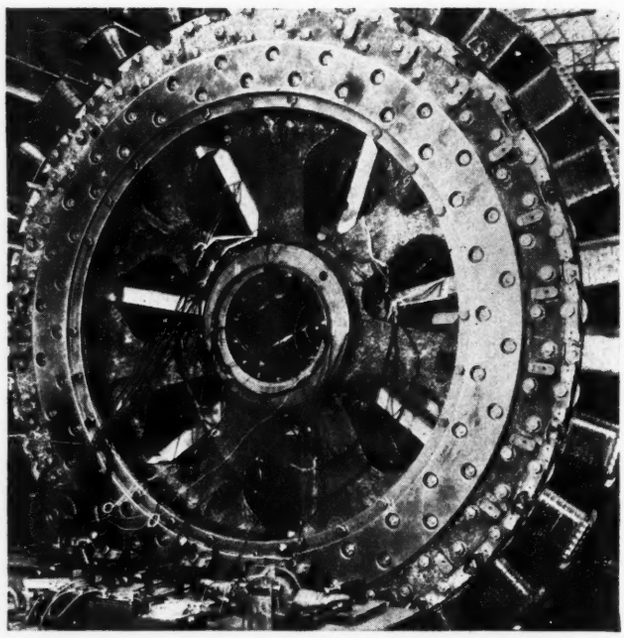


Fig. 1—Rotor ready for temperature run, with space heaters and thermocouples in place

Charcoal fires, oil and gas flames, steam heating, hot water and heating by electrical induction have all been used to heat rotors. In many recent installations, electric space heaters have proved very satisfactory. The use of electric heaters makes it possible to secure almost any desired temperature gradient, simplifies the temperature control, reduces the time and cost of the operation, eliminates the danger of fire and possible damage to insulation from smoke and soot, and permits accurate temperature and micrometer readings to be taken during the heating process. Heaters of this type are especially applicable when the rotor and shaft are assembled at some remote location or when the space is limited.

An interesting application of electric heaters for heating the rotor of a 33,000-kva. generator is shown in Fig. 1. Sixty-four heaters having a total capacity of 30,740 watts were used on this 255,000-lb. rotor. The total time required to expand the bore sufficiently to allow the shaft to enter without the use of pressure was $9\frac{3}{4}$ hr. Only a portion of the heaters was on for the whole period, and the power used was surprisingly small, 192 kw.hr.

Narrow metal-covered heaters were arranged within the bore, on the outside of the hub between the spokes and at the ends of the hub as in the figure. The fourteen 1,250-watt, 125-volt, 43-in. heaters used in the bore were fastened to rings at each end of the hub and were pressed firmly against the surface of the bore by two light steel rings. These rings were of such diameter that they were slightly elliptical in form when forced into the bore against the heaters. Although the hub was 48 in. long, it was not practical to use long heaters on the outside of the hub because of the enforcing ribs and the spokes. Forty-two 220-watt, 125-volt, 12-in. heaters were used. Bricks were placed against the back of each of the heaters and held in place by 2x4 in. wedges, Fig. 2. Four 500-watt, 125-volt, 24-in. heaters were

placed around each end of the hub and were secured by simply tying the ends together with wire.

All of the heaters on the outside of the hub were left on during the entire heating period to furnish the base heat. The circuits of the 1,250-watt heaters in the bore were manipulated to obtain the desired temperature control. These heaters were connected in two circuits with alternate heaters in the same circuit. Since no open flame was used in the heating process, the only covering required to keep the temperature gradient within safe limits was a tarpaulin. The folds of the tarpaulin were arranged to allow micrometer readings to be taken easily without an appreciable loss of heat.

Thermocouples were placed at suitable points about the hub and the leads were brought out to a temperature indicator on the test table. Temperature readings and micrometer measurements were made regularly until the bore was expanded sufficiently to admit the shaft.

While the rotor was being heated the shaft was cleaned, lifted into position and coated with a mixture of oil and graphite, which makes a better lubricant than white lead for the expansion method of assembly. The shaft and rotor were assembled with the shaft in a horizontal position. The weight of the rotor, the available rigging and the limited overhead room made horizontal more desirable than vertical assembly. After the desired expansion was obtained the tarpaulin was thrown off, the heaters within the bore were disconnected and removed, the bore was painted with the oil-graphite mixture and the shaft guided into place. All of these operations were completed in less than fifteen minutes.

Wherever a source of electrical power is available this method of expanding the bore of a rotor has been found to be much easier, more economical and quicker than any of the other methods that have been used.

Tests On Small Heating-Plant Stokers*

By J. F. Barkley

THE table shown below gives the results of a series of operating tests on two types of small stokers. One was an inclined, natural-draft, overfeed "hand stoker," fired and manipulated by hand. The other was a horizontal forced-draft, underfeed, mechanical unit stoker, operated by an electric motor. They were installed under 1,500-sq.ft. horizontal return-tubular boilers.

The steam load carried by these boilers was a rather typical heating load. It was fairly constant and of about 20 per cent rated capacity throughout the summer months, with small variations between day and night. During the winter months the daily variations were dependent upon the outside temperature. The boilers were banked a considerable part of the night.

Tests 1, 3, 4, and 5 in the table show the results obtained with the hand stoker. It was operated by the regular plant firemen, who probably did somewhat better than usual. Test 4, during which the firemen were permitted to see the CO_2 recorder, shows much improvement over Test 3, during which the recorder was covered. Slightly better results were obtained with coal B than with coal A. This was not due to the difference in the sizing of the coals, but rather to small differences in their actual burning characteristics.

The theoretical method of operating this type of stoker is to shovel the coal in at the front to form a mound-like pile. After some of the volatile matter is given off and caking has progressed, the coal is shoved down the stoker by operating the moving grates. In this way it is slowly advanced until at the bottom of the incline only ash remains, which is dumped into the ash pit. Under actual operating conditions, however, this method is not followed exactly. Whenever the grates are moved, especially if hurriedly, there is a sifting of fine unburned coal through them. This should be scraped from the ash pit and refired. Hence the grates are moved as infrequently as possible, and the firemen assist the coal movement with a hoe by shoving the coal mound at the front down over the grates. During the tests very little smoke was produced.

There was a decided improvement in the combustion when the CO_2 recorder was used as a guide. Practically no carbon monoxide was produced even at CO_2 percentages as high as 15 per cent.

Tests 2, 6 and 7 show the results obtained with the mechanical stoker. From 14 to 18 kw.-hr. was required for its operation per ton of coal fired. The motor was started and stopped automatically, as the steam pressure varied between chosen limits. Test 6 with coal A showed appreciably higher efficiency than Test 7 with coal B. This was due to the heavier caking characteristics of coal B.

The ideal coal for this type of stoker is a non-caking coal. With caking coal, masses of coke form in the fuel bed, and air channels or holes appear, through which much of the air passes, thereby increasing the flue-gas losses. With these conditions it is best to carry a thick fuel bed and bar the fire at times to break up the masses of coke and prevent channeling.

TABULATION OF OPERATING RESULTS

Test No.	Duration, Hours	Type of Stoker	Designation of Coal	Weight of Dry Coal Fired per Hr., Lbs.	Ash and Refuse, Per Cent by Weight of Dry Coal	Steam Pressure Lbs. per Sq.In. Gage	Temperature of Escaping Gases Leaving Boiler Average 24 Hr.	Temperature of Escaping Gases Leaving Boiler Average Day	Carbon Dioxide in Dry Flue Gases, Per Cent By Volume Average 24 Hr.	Carbon Dioxide in Dry Flue Gases, Per Cent By Volume Average Day	Percentage Rated Capacity Developed Average 24 Hr.	Percentage Rated Capacity Developed Average Day	Boiler Efficiency, Per Cent Average 24 Hr.	Boiler Efficiency, Per Cent Average Day	Remarks
1	240	Hand over-feed	(A) Run of mine	118	11.2	30	318	337	3.5	3.9	22.1	....	64	..	.....
2	480	Mechanical under-feed	Run of mine	90	8.1	30	310	320	4.9	5.9	18.9	...	72	..	.....
3	384	Hand over-feed	Run of mine	274	9.9	30	375	558	4.3	9.4	51	123	64	68	CO_2 Recorder not used by firemen.
4	288	Hand over-feed	Run of mine	371	7.6	30	464	615	7.2	12.9	73	153	68	71	CO_2 Recorder used by firemen.
5	336	Hand over-feed	(B) 1¼-in. nut and slack	301	10.8	30	405	585	4.8	10.0	55	133	65	68	CO_2 Recorder not used by firemen.
6	456	Mechanical under-feed	(A) Run of mine	231	6.2	30	397	502	6.2	10.6	48	110	72	74	.....
7	120	Mechanical under-feed	(B) 1¼ in. nut and slack	216	6.4	30	402	550	5.0	9.3	42	120	68	71	Coal used caked much more than that used in Test 6.

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Accurate Repair Records Essential To Efficient Maintenance Methods

By WALTER N. POLAKOV*
Consulting Engineer, New York City

This is the tenth in a series of standard instructions for power plant management, which has been developed from the author's many years of experience and proved successful by application in many plants.

MEN differ from animals because they record their experience and learn from it. A power house without records resembles a pig pen in more than one way.

Maintenance records if accurate and complete help to select the most suitable materials, parts and supplies. A study of such records shows the best way of doing repairs. The intelligent use of records tends to make operation safe, uninterrupted, more comfortable, and more economical.

REPAIR RECORD

Object: For each unit of equipment, a record card (Form——) is kept in the power plant office for the purpose of:

1. Recording of manufacturer's data of a unit.
2. Recording alterations made.
3. Recording drawing and catalog number.
4. Recording nature and cost of repairs made.

Repair Orders: Repairs ordered by the chief engineer, on Form———, are attended to by the maintenance man or by the mechanical department.

White (original) copy of order goes to Mech. Dept.

Yellow copy of order goes to Mech. Dept.

Blue copy of order is returned with order number to power plant board.

Stores issued to the job are ordered on Form——— and charged to the order number.

When the job is completed the blue copy of the order is checked, O.K'd and stamped "order completed," with the time and the date of completion. The yellow copy is sent from the mechanical department, checked, O.K'd, stamped "completed" and returned.

Figuring out the total cost of labor, stores and overhead is done by the mechanical department and entered on the back of the original (white) order. This priced order is then sent to the power plant clerk for entry in the records.

Repair Record: The chief operating engineer or clerk enters these costs on the "repair record" card on file in the power plant showing labor and material separate and total, including overhead. He also checks and verifies the time taken and enters on the card the date the unit was taken out of service and days or hours it was out of service.

The nature of the repair must be clearly and concisely stated, specifying if any new materials were used, such as new brand of fire clay or new make or grade of valves, etc., giving trade names.

Cost of repairs made by the power plant force is ascertained from time cards and stores issued, and entered on cards in the same manner.

Total expense of repair entered on all cards during a month must be equal to total maintenance charge on the monthly cost analysis report.

Filing and Reference: All repair record cards are kept in a special file in the power house, entered monthly and totaled up quarterly to show the amount expended for upkeep of each unit of equipment.

The chief operating engineer and mechanical superintendent analyze these repair records, decide which material and what method gives the best satisfaction and which is the cheapest supply and material to use, irrespective of its purchase price.

From the accumulation of this data, maintenance standard practice is worked out and new instruction cards prepared.

EXAMPLE OF INSTRUCTIONS FOR ANNUAL INSPECTION OF TURBINE-GENERATOR

1. Drain off all lubricating oil from the unit.
2. Remove end bells from the generator.
3. Take bearings 3 and 4 apart.
4. Take the flexible coupling apart.
5. Remove the field from generator and place it on the floor.
6. Remove bolts from turbine cylinder and turbine bearings.
7. Lift off the governor and place it on the floor.
8. Take turbine bearings 1 and 2 apart.
9. Lift off turbine top cover and place it on the floor.
10. Lift turbine spindle from the bottom cover and place it on blocking on the floor.
11. Clean out air ducts in the generator. Clean and paint coils. Clean and paint field if necessary.
12. Inspect blading in turbine top and bottom covers. Inspect dummy strips in both covers. If any blades or dummy strips are found loose, tighten them up with tools made for this purpose. Great care must be taken when doing this part of the work.
13. Inspect the water gland piping and runners. File the clearance on these runners, if necessary.
14. Paint top and bottom turbine covers, also the turbine spindle in both ends where corrosion takes place with red lead and linseed oil.
15. Take the governor apart. Take up the lost motion. Repair or renew any worn-out parts. Reassemble the governor ready for installation on the turbine.
16. Take the automatic governor part from the turbine

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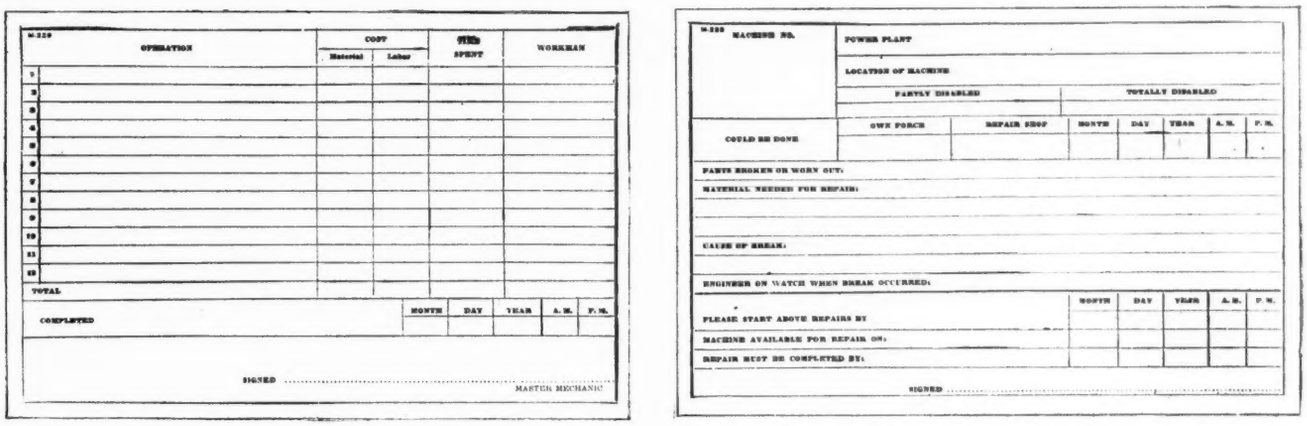
spindle. Inspect it for worn parts. Replace any worn-out parts and reassemble.

17. Take the primary and secondary valves apart. Inspect them for lost motion. Carefully grind in valves on their seats. Repair or replace worn parts. Reconnect valves to turbine top cover, making it ready for replacement when work has been completed.

28. When the field is lined up, move it back and connect up with flexible coupling. Put the field back in place, put in bolts, cotter keys, and wire in the couplings.

29. Bolt down No. 4 pedestal and connect oil piping, after blowing it through with steam. Put on the bearing covers and connect up the governor to the primary and secondary valves.



Two types of order forms used in keeping repair records

18. Scrape off all hard spots on the turbine and the generator bearings, and clean out all oil channels with compressed air.

19. File out worn grooves on flexible couplings and clean out oil holes with air. File out worn grooves on couplings of turbine spindle and field.

20. Clean and inspect thrust bearing for turbine spindle.

21. Clean out turbine bottom cover with compressed air and place the lower half of thrust bearings and lower halves of turbine bearings 1 and 2 in position.

22. Lift the turbine spindle from the floor and place it in its position in the lower turbine cover. Great care must be exercised when doing this, so that no damage to the blading will occur.

23. Put on upper halves of the turbine bearings.

24. Lift top cover from the floor and place it in position over the turbine, lowering it to within 8 in. of the joint. Paint graphite and oil on the joint of the lower turbine cover. Place a soft gasket in its position on the steam pipe. Lower the top cover and put in the bolts, starting to tighten them at the center of the cover and working out to the both ends.

25. Place a level on the turbine spindle and level it by raising or lowering bearings 1 and 2. Then lower the turbine spindle until the blading scrapes lightly in the bottom cover. Take notice of the position of bearings 1 and 2 when this occurs. Then raise the bearings until the blading on the spindle scrapes lightly on the top cover. Take notice of the position of bearings 1 and 2 when this occurs. The difference in the initial and final positions of the bearings will be the total clearance of the turbine spindle blading in the cover. Divide this total clearance by two, and add 0.010 in. to give bottom clearance, placing the spindle 0.010 in. above the center. To take side clearance perform the operation as above, but place the spindle exactly in the center position. Final adjustment of clearance must be recorded on the log.

26. Place the top of thrust bearing in its place. Lift the governor from the floor, graphite joint and connect to turbine cover.

27. Place the field in its bearings and line it up with the turbine spindle.

30. Lift up covers on oil cooler and reservoir, clean out coils and piping and reconnect.

31. Put clean oil in cooler, reservoir and bearings. Record on log the grade and quantity used.

32. Start turbine slowly and take end clearance of spindle. Set the spindle to its operating position. Run the turbine full speed and see that this is correct. Shut down and put the end bells on the generator.

33. When this work is completed the task (of inspection) is finished. Report the unit ready for service.

Removing the Explosion Hazard From Electrical Equipment

THERE are plants where dust, explosives, or inflammable materials are present. In such plants a dangerous hazard exists, because a small spark or arc may ignite the dust or inflammable material, causing a serious explosion. When such an explosive condition is present it is advisable to install specially constructed and inclosed electric motors. When an attempt is made to inclose ordinary electric motors there is danger of their overheating if nearly loaded. Sometimes they can be successfully inclosed by using a blower to bring in cool fresh air. Such an arrangement will keep the motor fairly clean. But as a safe measure in rooms where there is danger from igniting inflammable material it is better not to take the chance of inclosing the ordinary motor to prevent sparks escaping. When motors are to be used where explosive vapors or material is near, the squirrel-cage type is preferred. Storage batteries offer another explosive hazard. They should be placed in a room by themselves, and no one should be allowed to enter the room except a properly qualified person. When batteries are placed in such rooms care must be exercised to provide for proper ventilation, so that the acid fumes and inflammable gases will be removed. Under no conditions allow open flames to be brought in or near a battery room. When a battery is being charged considerable gas is given off which is inflammable and may cause a serious explosion if ignited.

Chart for Finding Pressure Drop in Steam Piping

By W. C. Woodman
Brooklyn Edison Company

THE process of laying out a system of steam piping is essentially one of trial and error, more variables being involved than can be handled in a direct solution. Generally, the length of the system, the flow to be carried and the conditions of the steam are known. The problem then becomes one of making one or more solutions of the correct mathematical relation involving these several variables, using trial diameters, until a minimum diameter is found which produces a pressure drop within the allowable limits.

The best means for determining the pressure drop in steam piping that has come to my attention is due to McAdams and Sherwood*. These authors demonstrate not only the true relation of the several variables, but also present a "friction factor" curve, plotted from a compilation of many tests. This method is superior to the older Babcock and Unwin formulas in that this friction factor is plotted not against some assumed function of the diameter, but against its true function, involving a number of variables. This function is a true one, as demonstrated by the fact that all test points, representing a variety of conditions, lie on a smooth curve.

It can be demonstrated that the pressure loss in pipe lines having the same relative surface "roughness" is a function of the product of two dimentionless parameters:

$$p = f\left[\frac{DvS}{Z}\right]\frac{Lv^2W}{6gD}$$

In this expression the symbols denote the following:

p = pressure drop—lb. per sq.in.,
D = internal diameter—in.,
v = velocity of flow—ft. per sec.,
S = specific gravity of steam,
Z = viscosity of steam—centipoises,
L = total equivalent length—ft.,
W = specific weight of steam—lb. per cu.ft.,
g = acceleration of gravity—32.2 ft. per sec.^{2}

This equation is similar to the old hydraulic formula:

$$p = \frac{mLv^2w}{6gD}$$

where m, the "friction factor," has been replaced by $f\left[\frac{DvS}{Z}\right]$, and where the plot of $f\left[\frac{DvS}{Z}\right]$ or m against the dimensionless parameter $\left[\frac{DvS}{Z}\right]$ appearing in the original article gives the test-correct friction factor to use in this equation. This function is plotted in Fig. 1 as derived from the data compiled by Professor McAdams. By employing the values from this curve in the equation, the friction loss in a given system of piping, or the diameter of a new system can be determined for the given steam conditions and flow.

This equation, however, is of a type that involves some arduous calculation of a trial-and-error nature. Moreover, the average engineer has little to do with viscosity and specific gravity of steam, and thinks in terms of hourly flow rather than of velocity. The equation can be transformed to read: $p = f\left[a\frac{F}{DZ}\right]b\frac{F^2LV}{D^5}$ where F = flow—lb. per hr. V = specific volume of steam —cu.ft. per lb., a = 0.000817, and b = 0.0000134.

Inspection of Fig. 1 will show that over a large range of values of $\left[\frac{DvS}{Z}\right]$ (in this range most cases met in practice fall) $f\left[\frac{DvS}{Z}\right]$ is constant at 0.0054. Concerning ourselves for the moment with this constant value for $f\left[\frac{DvS}{Z}\right]$, we may write:

$$p = 0.0000000723\ \frac{F^2LV}{D^5}$$

This relation has been plotted in the alignment chart, Fig. 2.

To use this chart, proceed as follows: Enter the chart with the average pressure in the system. This may have to be estimated at first, but pressure has so little effect upon the resultant pressure drop that with a little practice, the correct result can be found with but a single trial. Rise vertically to the correct superheat. Move horizontally to the specific volume scale. It is unnecessary to read this value, the scale being useful only when this quantity is known rather than the other two steam conditions. Lay a straight edge across to the flow scale between the correct values of V and F, and mark the intersection on the intermediate axis q. From this point lay the straight edge across to the known

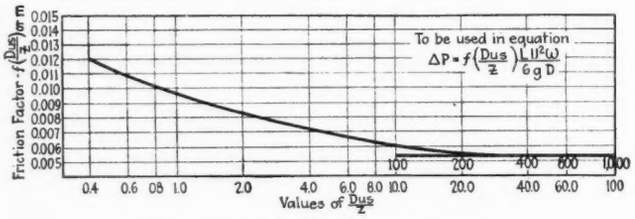


Fig. 1—Friction-factor curve

length L, marking the intersection on the intermediate axis t. With stylus resting on this point, and with the known diameter (as for an existing system), read the pressure drop by laying the straight edge from D to p through t. If the diameter is unknown, rotate the straight edge about the point on t, between the D and p scales, until a diameter is found compatible with an allowable pressure drop. The use of this formula for drops of more than 10 per cent of the initial pressure is not warranted.

For the great majority of cases the resulting pressure drop needs no further correction. In a few instances involving unusually low velocities a region of Fig. 1 is involved in which $f\left[\frac{DvS}{Z}\right]$ is greater than 0.0054.

It will be noticed that this takes place when $\left[\frac{DvS}{Z}\right]$ is less than 30, or when $\left[\frac{F}{DZ}\right]$ is less than 36,800. To check the result from Fig. 2, proceed as follows: Having determined the viscosity from curve A Fig. 3, (viscosity data are very meagre, but this curve is sufficiently accurate for the purpose), enter the chart B and read the value of the parameter $\left[\frac{F}{DZ}\right]$. If $\left[\frac{F}{DZ}\right]$ is less than 36,800, the pressure drop requires correction. Enter curve C with $\left[\frac{F}{DZ}\right]$ and read K. The true pressure drop will be that from Fig. 2 multiplied by K.

*Mechanical Engineering, October, 1926.

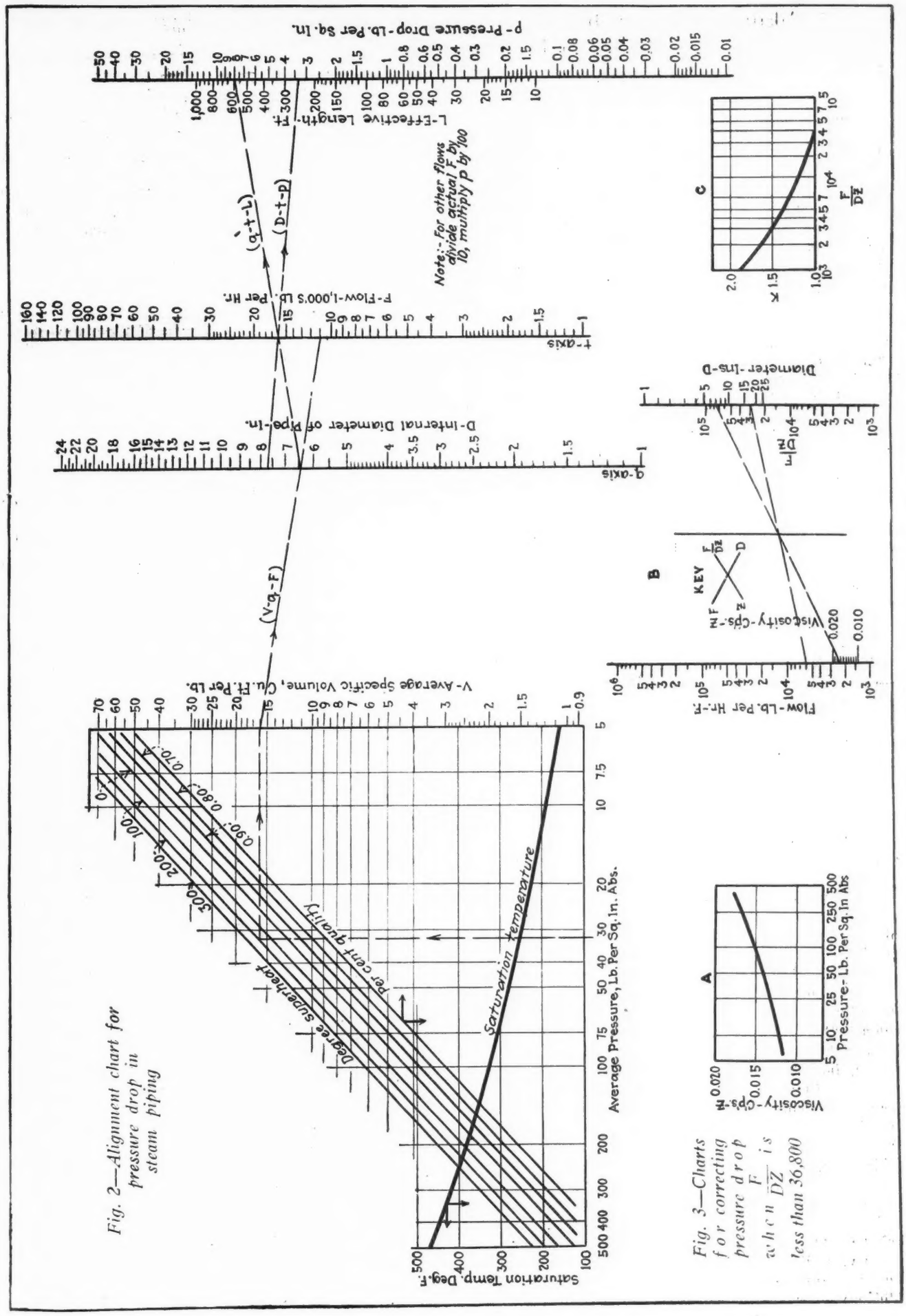

P - Pressure Drop - Lb. Per Sq. In.
L - Effective Length - Ft.
(q-t-L)
(D-t-p)
Note:- For other flows divide actual F by 10, multiply P by 100
F - Flow - 1,000's Lb. Per Hr.
t - axis
D - Internal Diameter of Pipe - In.
q - axis
(V-q-F)
V - Average Specific Volume, Cu. Ft. Per Lb.
Saturation Temperature
Degree Superheat
Per Cent quality
Saturation Temp. Deg. F.
Average Pressure, Lb. Per Sq. In. Abs.
C
K
Diameter - Ins - D
B
KEY
Viscosity - Cps. - N
Flow - Lb. Per Hr. - F
A
Pressure - Lb. Per Sq. In Abs
Viscosity - Cps. - N

Fig. 2—Alignment chart for pressure drop in steam piping

Fig. 3—Charts for correcting pressure drop when $\frac{F}{DZ}$ is less than 36,800

Taking the Safety Out of Safety Switches

By Marin Phillips

Electrical Superintendent
International Paper Company, Niagara Falls, N.Y.

A PRACTICE that is a source of accidents to machine operators and other workmen in many plants and should be discouraged, is allowing them to change fuses and make minor repairs, test, etc., because they have seen the engineer or electrician do it that way. Machine operators have been known to pry the covers off safety switches to get at the fuses. They were not aware that if they first opened the switch the cover would open easily. In other cases they have been burned by testing circuits with a single 110-volt lamp, where two or four in series should have been used. In one instance a foreman changed the blown fuses during the night. This he had done for several years, but one night he did not find the test-lamp bank and used a single 110-volt lamp on a 440-volt circuit, and was badly burned. This resulted in a night electrician being put on—but does it require such an accident in plants to drive home the necessity of having electrical work carried out by those who know what they are doing?

It was due to so many accidents occurring on open-type knife switches in industrial plants that the present types of safety switches were developed. The safety switch is a knife switch inclosed in a sheet-metal cabinet and arranged to be operated from outside of the cabinet. This arrangement guards the switch against being short circuited by a piece of metal pipe accidentally brushing across the blades.

The inclosure also protects the workmen from being shocked by accidentally touching the blades when opening and closing the switch. It further saves the workmen from shocks as a result of something they are carrying accidentally coming in contact with the switch, as often happened when open-type switches were the type generally used.

Safety-Switch Development

A great deal of progress has been made toward developing a real safety switch. A safety switch in order to be safe must be foolproof. When the safety switches were first developed the door on the cabinet could be opened with the switch closed. At this stage of development, plant workmen were so used to handling live open-type switches that they would, in many cases, change the fuses without opening the switch. The next important step toward a good safety switch was the addition of a locking device to prevent the switch cabinet door being opened while the switch was closed. The introduction of the locking device was a boon for safety, but this switch was inconvenient when it was necessary to open the cabinet door for inspections and tests. In many cases the first operation on the new switch was to saw off or otherwise make inoperative the safety catch, so that the cabinet door could be opened without having to open the switch.

The next development was safety switches designed so the cabinet door could not be opened with the switch closed nor could the switch be closed with the cabinet door open. This type of safety switch is satisfactory, as keys are provided to open the cabinet door for inspections and tests while the switch remains closed. This gives ready access to authorized persons and assures safety for those who are unauthorized to make such inspections and tests.

It is probable the name "safety switch" causes many workmen to think that the switch is safe and that it will prevent accidents regardless of everything. This is a mistaken idea, and serious accidents and burns have occurred because ordinary precaution was not observed while operating and making repairs on them. Safety switches will not "think" any more than the old-type open switch. From the number of accidents that happen to workmen while working around safety switches, one is led to believe that the only way to prevent accidents is to develop a safety switch that will "think."

Possibilities of Short Circuits

There is a possibility of short circuiting a safety switch by the metal rod or bar across the top of the switch blades to which they are fastened. Conditions may develop that will cause this bar to make contact directly across the blades. The insulation on the bar may give out due to age or to moisture and chemical fumes being present or the switch may be worn by long use, allowing the parts to get out of line. The switch may be closed with such force on the handle as to cause the insulation to fail and push the closing bar across the blades.

When a safety switch remains in the closed position for a long period without being opened it may have a tendency to stick, making it hard to open, especially in damp places or where corrosive fumes are present. When a safety switch is stuck closed, great care must be used when attempting to force it open so as to not apply sufficient force to damage the insulation and cause a short circuit. If possible, the power should be shut off and the switch carefully opened. The joints should then be cleaned and oiled so that they will work freely. Some bad burns have occurred from attempting to force open safety switches that were stuck shut. One bad accident comes to mind where it was desired to open a safety switch that had stuck closed. After pulling and working with the switch handle trying to open the blades without avail, an attempt was made to pull the switch open. A rope was tied to the cross bar that operated the blades, and three workmen tried to pull the switch open. They were near enough to be burned by the flash which occurred when the switch was short circuited as a result of applying too much force to the cross bar of the switch.

Preventing Accidents

In order to prevent such accidents two things are necessary. One is to keep the switches working freely, so that no undue strain will have to be applied when opening or closing them. Secondly when a switch has become stuck and will not open freely, it is best to take no chances in trying to force it open. Safety switches are frequently installed on the walls or ceilings, where a ladder is necessary to open or close them. Under these conditions maintenance men will, wherever they can, trip out the oil switch on the switchboard rather than use a ladder to open the safety switch. This will be practiced for some time, and when it is necessary to open the safety switch it may be found stuck too tightly to be opened easily. This is bad practice and should be discouraged among the workmen. Every time a starting box or any other piece of control equipment is inspected the switch should be opened. If it has any tendency to stick and not work freely it should be cleaned and oiled and put in proper working condition.

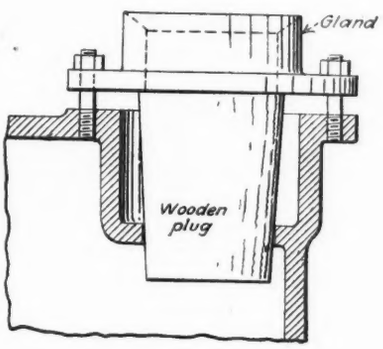
Right Out of the Plant

Keeping a Triplex Pump in Operation While Undergoing Repairs

A TRIPLEX pump was badly in need of an overhauling, and although it was on intermittent service, it could not be shut down long enough to complete the job at one time.

The plungers needed re-turning, the crossheads needed new pins and new bushings and the crosshead shoes needed shimming out and re-turning. After some thought it was decided to do the job one cylinder at a time, and to keep the remaining two cylinders in operation as needed.

To accomplish this, the connecting rod of the cylinder



Wooden plug used to seal plunger opening while repairs were being made

to be worked on was disconnected from the crank pin, and it and its plunger lifted out of the cylinder.

Upon trial it was found that enough air leaked in to prevent the other cylinders from lifting the water, so a wooden block was turned to fit in the stuffing box, and the gland turned over and tightened down on the plug, as shown in the accompanying sketch. In this way the pump could be operated as needed on the two remaining cylinders, and the overhauling was much more complete than if it had been hurried. EARL PAGETT.

Coffeyville, Kan.

Shorter Days or Fewer Years?

THE broad viewpoint and logical conclusions of *Power's* forewords have invariably inspired my enthusiastic approbation, but "Shorter Days or Fewer Years," in the July 9 number, does not arouse similar ready acceptance of its advocacy of working longer days with the corresponding prospect of working fewer years.

Accepting the "yardstick" that all the world's work now done in eight hours can be done in five hours if every one worked, and for convenience we set the starting age for beginning to be gainfully occupied at 16 years and the end of such activity at 64. This makes a period of 48 years of productivity.

You point out that if every one keeps working eight hours, people would ultimately have to work fewer years, only five-eighths of their working life, or 30 years.

If the working period is assumed to start at age 16, this would make the retiring age 46 years, with a prospect of enjoying many years of complete leisure.

Now is it not a fair question to ask whether the average man employed at present average wages will be able to withdraw from productivity at that age and live thereafter on the savings from his present wages after decently providing for his family, giving his children a fair amount of education, paying for ordinary sicknesses and other accidental contingencies during a normal life?

I think the answer is "No, it cannot be done unless all who are over 46 should now retire, whereupon the younger workers would all be paid higher wages so they could save three-eighths of their income and live as well as they do now."

Well, how are the many thousands of people over 46 who are now employed to be able to quit thus abruptly? These constitute three-eights of the total, or nearly 40 per cent.

Would it not be necessary, in order to make such a start, to pension all who were 46 or over, as well as others who were approaching the critical 46-year age limit at the time the new scheme was inaugurated? After a period of 18 years such pensions would cease and the scheme should continue to operate smoothly and satisfactorily without any drawbacks.

Come to reason it out some more: If the younger workers get three-eighths more pay, and have to expend it for supporting those over 46, they will not be able to save for their own future, so must look forward to themselves becoming charitably supported after reaching 46.

Now we see no such vexatious difficulties involved, were five hours to constitute a day's work for the same wages as now paid for eight with everybody continuing to work more happily under a five-hour day régime. Another advantage would be, that the reduced hours would be less burdensome to the older workers than at present and all could continue to look forward to being employed as long as they were capable.

I doubt very much if the average worker is extravagently dissipating three-eighths of his present wages which could be saved. H. G. BRINCKERHOFF.

Boston, Mass.

Lubricating Commutator Brushes

IN MANY cases where hard brushes have to be used owing to the operating conditions there is considerable friction and screeching at the commutator owing to the lack of lubricant. The performance of these brushes can be improved by lubricating them as follows:

The brushes should be slowly heated to a dull red on an iron plate and then plunged in machine oil, where they should remain until cool.

Another method is to boil the brushes in paraffin wax. This has the same effect; but must be done with due care and not be heated by an open flame, for heated paraffin wax gives off inflammable vapors.

The effect of this treatment is to cause part of the oil to enter the brush, which furnishes sufficient lubrication to enable the brush to run quietly, but not enough to cause smearing of the commutator. W. E. WARNER.

Brentford, England.

Using A.-C. Motor Compensation Reduced Voltage

THERE sometimes develops a need for using an induction-motor starting compensation on a lower voltage than that for which it is designed. An example of this is to use a 440-volt compensation to start a 220-volt motor. This may be done in several ways, provided the motor is not too large. The capacity of the compensator decreases almost in direct proportion to the voltage. That is, if a 50-hp. 440-volt compensator is used on a 220-volt circuit, without regrouping the coils, it would be good for only about 25 hp. It may be necessary to change the taps to give a higher percentage of starting voltage for the new condition than for the old, but the connection should work, even if the transformers have twice the number of turns in series they should have for the low voltage.

A method that I have used on a number of occasions is to connect the auto-transformers in delta. This can be done only where there are three auto-transformers. Fig. 1 shows the original star grouping of the auto-transformers and Fig. 2 the grouping after they are connected in delta. When the transformers are connected in this way, they are good for 58 per cent of the star-connection voltage, or $440 \times 0.58 = 255$ volts. If this connection is used for 50 per cent voltage (in this case 220) the transformer's capacity is only about 50 per cent of the star connection.

When the transformers have a 50 or a 40 per cent tap on them, the best arrangement will be to use these taps for the star connection as in Fig. 3. With this connection it may be necessary to use the highest starting tap to get sufficient voltage for starting the motor, if it has to start appreciable load. When this method can be worked, it is probably the best of the three. At best all three arrangements are makeshifts and should be used in emergency only or as a means of utilizing existing equipment. If the no-voltage release coil is to be used on one-half the original voltage it will probably be necessary to rewind the coil with one-half the number turns and wire twice the size used in the higher-voltage winding.

Many squirrel-cage induction motors are started on full voltage even in large sizes. In an emergency, where a compensator has failed or one is not readily available, it may be possible to start the motor by connecting it directly to the line. If the motor is to be started in this way, it is necessary that the ends of the stator coils be securely braced to stand the magnetic forces produced by the starting current. On medium-sized motors this can be done by lacing the coil ends to insulated rings placed around the outside of the winding. If the motors can be started in this way, the effects of the increased torque on the machine and the drive must be considered, as there is danger of breaking machine parts if they are subjected to a severe shock at starting.

Cleveland, Ohio. C. O. ROBERTS.

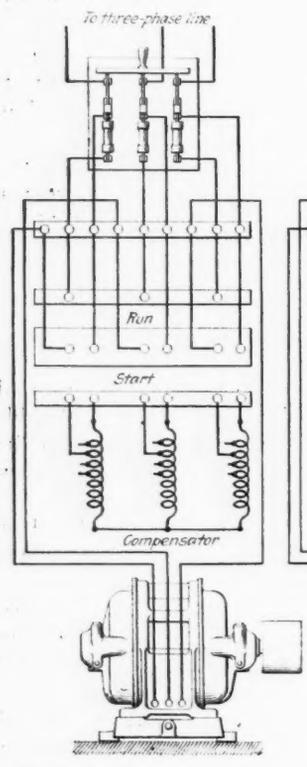


Fig. 1 — Compensator with auto-transformers connected star.

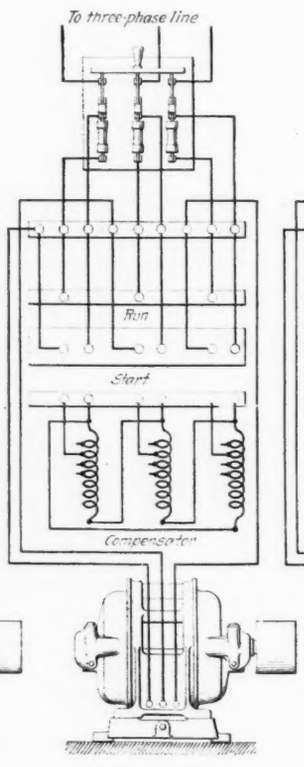


Fig. 2 — Compensator with auto-transformers connected delta.

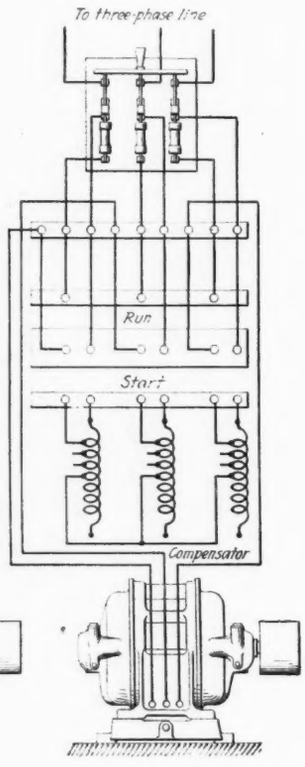


Fig. 3 — Auto-transformers connected star at the lowest voltage taps.

Misalignment Causes Fracture of Brine Propeller Shaft

A BREAKDOWN in an ice making plant recently occurred through the fracturing of one of the impeller shafts that circulated the brine. This fracture occurred just inside the gland after the shaft had been in service some 13,000 hours.

Two 1½-in. steel shafts were used to drive impellers 18 in. in diameter at a speed of 26 r.p.m. An examination of the fractured shaft showed a slight corrosion, evidently caused by the brine having had at some time an acid reaction.

This corrosion was not sufficient, however, to have caused the fracture, and on testing the alignment of the shafts it was found that they had both been working out of line and the resultant stress had led to the fracture. The fracture was a corrosion fatigue brought about by the shaft having been overstressed in the presence of a corroding medium. The external loads on the shafts were light and the overstress had been totally brought about by the misalignment.

This shows the importance of keeping these shafts well in line for not only is additional power absorbed through their being out of line, but the shaft is always liable to fracture through the overstress thus caused.

Steel is not a satisfactory material for making shafts that have to work in brine. Muntz or Delta metal shafts are more satisfactory for this work. W. E. WARNER.

Brentford, England.

Discharging Safety Valve Into Low-Pressure Turbine

IN THE June 18 number of *Power* "A.M.D." brings up the question of discharging his safety valve into a low-pressure turbine, which is not in accordance with the A.S.M.E. code.

Possibly he could leave the present safety valve and install another set at two or three pounds lower pressure and discharge the lower pressure valve into the turbine. In this way he could save most of the steam now wasted and still be protected, as in case of back pressure, on the new safety valve. The original valve would blow to atmosphere, thus complying with the code. It might be well to install a valve in the new discharge line which could be closed frequently enough to be sure that the original safety valve was operating properly.

Racine, Wis. J. J. WYNHOFF.

Steam Cylinder Lubrication

WITH the advent of the high-pressure boiler in industries using process steam, engine cylinder lubrication has created new problems. With working pressures of 600 lb. and over, the danger of introducing oil into the boiler is a serious one. In a plant operating at 250 lb., with usual boiler house supervision, a small quantity of oil introduced into the boiler does no great damage, but a water-tube boiler working at 600 lb. pressure, with tubes coated with a thin layer of soft scale containing 30 per cent or so of oil, would be dangerous, to say the least.

It is usual practice to separate the excess cylinder oil from the exhaust steam as it leaves the cylinder, but complete separation is impossible, some oil being carried along with the steam flow. With baffle-plate separators and oil flanges this might partially, but not completely, be removed.

As the oil particles in the steam carry a negative charge, it might also be possible to separate these with some type of high potential electrical filter. With my knowledge of this type filter for removing dust from gas, I believe they might be built to remove up to 95 per cent of the oil in the steam, but what operating engineers require is a filter that will operate continuously at 100 per cent efficiency. Such a separator has not yet been constructed.

If we leave the oil-separating operation until the steam has been used in process and eventually has condensed, the problem is not quite so difficult.

As the oil globules in a water-oil emulsion are from 0.006 to 0.0006 millimeters in size, no type of toweling or fiber filter will remove the oil completely.

Electricity can be used for removing oil from water, in which case the condensate flows through a wooden chamber in which electrodes are fixed. The small oil globules are coagulated by this process and are then filtered out. This process is said to give good results, but has the drawback that the operation must be carried on at atmospheric pressure and therefore cannot be considered where the condensate is returned to the boiler feed pumps under pressure.

With some of the chemical filters now available, the prospects appear, on first sight, to be more promising. In fact, some of them will remove all oil from the condensate, but in doing so they introduce certain detrimental elements into the feed water.

By using an aluminum salt, usually aluminum sulphate in conjunction with soda, as a coagulant, a precipitate can be made sufficiently dense to trap all traces of oil. Careful attention to the operation of this plant is necessary owing to the acid nature of the aluminum sulphate. In any case, sodium sulphate is formed, and if introduced into the boiler it will eventually cause priming, necessitating frequent blowing down with a consequent loss of heat.

A process has been developed in France in which it is claimed that traces of oil can be removed from condensate by passing it through an ultra filter, the filtering medium being collodion, denatured nitrocellulose or cellulose acetate. I am not familiar with the details of this process.

All these appliances have been developed to catch the surplus oil. That being so, it would seem that the easiest way out of the difficulty is to apply the necessary quantity of lubricant in such a manner that there is no excess, but at the same time give the necessary lubrication. Recommendations made by lubricating specialists are much above the actual oil requirements. Figures such as 0.3 grams or 4.5 grains per horsepower-hour are in excess of that found to be necessary in an experiment carried out on an engine under actual operating conditions.

The line of investigation followed was to introduce water in the cylinder and reduce the oil quantity. Steam was taken from the steam chest, run through a small condenser and re-introduced into both cylinder ports between the inlet valves and the cylinder, the whole operation being automatic. When the main stop valve was opened, steam passed into the steam chest at 250 lb., of which a small supply went to the condenser. The reduced pressure in the cylinder during the expansion and exhaust periods of the piston stroke allowed the condensed steam to pass into the inlet ports. It was then carried along with the next rush of steam into the cylinder.

Before this experiment was made, 0.16 grams, or 2.4 grains, of oil was fed to the engine per horsepower-hour. After the water feed was installed, the oil supply was gradually cut down until nothing was fed to the cylinder but 0.4 grams, or 0.6 grains, per horsepower-hour to the gland. Water was used at the rate of twenty pounds an hour. The oil used was a high grade mineral made from Pennsylvania crude.

This engine has now been running for a considerable period, and recently, after a 2,000-hour run, was opened up. The cylinder walls were found to be in as good condition as the best lubricated cylinder walls possibly could be. There was quite a good film of oil all over the wearing surface, which no doubt entered the cylinder at the gland, the water seeming to have the action of keeping this small quantity of oil where it was most needed. There is no doubt that the quantity of oil used could be further reduced. But with the existing gland packing the piston rod is inclined to heat up. This is an example where the textbook recommendation of 0.3 grams of cylinder oil per horsepower-hour has been reduced to 0.04 grams per horsepower-hour. If we assume that 50 per cent of the oil fed to the gland finds its way into the cylinders, then the quantity used to lubricate the piston is reduced to 0.02 grams. Test of the exhaust steam showed that it contained less than 0.2 parts per million of oil. The exact quantity could not be determined. CHARLES BOEHM.

Victoria, Australia.

What's New in Plant Equipment

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING TRANSMITTING AND APPLYING THE POWER SERVICES

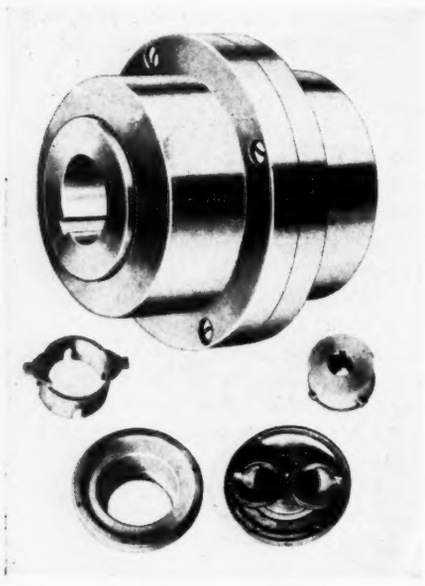
Flexible Coupling With Two Ring-Shaped Flexing Elements

THE distinguishing feature of the flex-ring type of couplings put out by the T. L. Smith Company, Milwaukee, Wis., is the employment of one or more ring-shaped springs to transmit the load and at the same time give the necessary flexibility between the driver and driven machine.

In the two models of this type of coupling described in the Oct. 16 and Dec. 18, 1928, numbers of *Power* the ring-shaped springs were made to fit around the shaft hub of the coupling with a projection on each half fitting into a common gap in the ring.

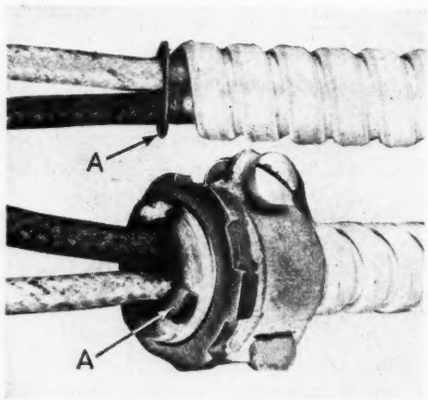
In the new type, illustrated, essentially the same principle is employed, but two smaller rings placed diametrically opposite are used instead of one going completely around the shaft hub.

The illustration shows a complete assembly of the coupling, an assembly of one-half of the coupling with the two rings in place and separate views of the shaft hub, sleeve and coupling housing. The projection on the floating sleeve fits into the opening in the rings, and the pins in the shaft hub, in turn, fit into milled slots in the sleeve. The outer housing does not transmit torque. It serves only to keep the torque members in alignment and as a retainer for the lubricant.



View of coupling assembled and unassembled

A similar style of coupling is available using four ring-shaped springs instead of two. The bore sizes range from $1\frac{1}{4}$ to 6 inches. Larger sizes can also be supplied.



Fiber bushing protects conductors at end of steel armor

Double-Armored, Bushed Cable

A FORM of armored cable embodying new features and designed to more completely eliminate shorts and grounds at the points where the cable enters the fitting is illustrated. On the new cable the wrapping between the conductors and the steel can be stripped and trimmed by hand without the necessity of cutting with a sharp instrument, as has to be done when the covering is a braid or weave. Also, an insulating bushing of red fiber is inserted at the end between the conductors and the steel armor.

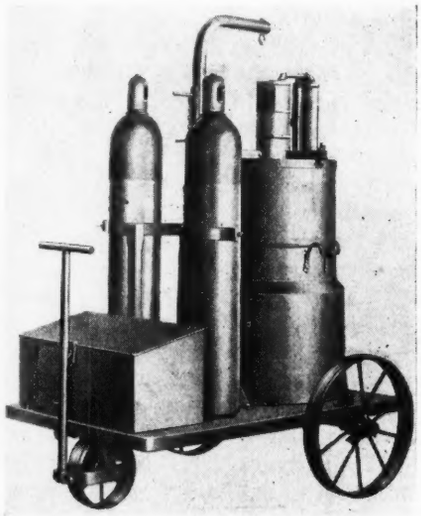
The bushing has a longitudinal gap to permit its being clasped over the conductors from the side. It is then pinched together and overlapped before being pushed into place, as shown at *A*. It also has a rolled end. The cable is being put out by the National Electric Products Corporation, Pittsburgh, Pa.

Trucks for Low-Pressure Acetylene Generators

TWO TYPES of trucks designed to accommodate its two models of low-pressure acetylene generators are recent additions to the line of welding equipment put out by the Oxweld Equipment Company, 30 East 42nd St., New York City.

The truck illustrated is designed to carry the CLP-3 Carbic generator and two cylinders of oxygen. The generator is fastened to the truck by angle braces and long bolts with turn buckles, while the oxygen cylinders are chained to a steel rack fastened to the deck of the truck. A steel box is provided at the front for carrying tools and the welding and cutting outfits.

To facilitate the lifting of the gas bell out of the generator when recharging, a crane is provided, as shown. The crane jib is made in three sections, which can be telescoped when not in use to reduce the height. The truck is fitted with two 24-in. wheels at the rear and a 12-in. castor wheel at the front.

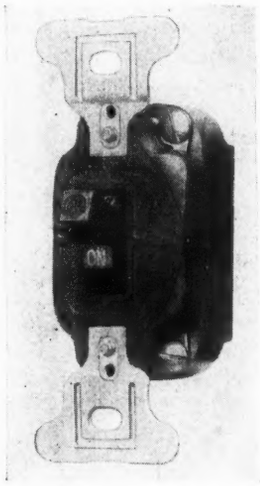


Truck carries generator and two oxygen cylinders

A small truck for the type CLP-2 generator accommodates one cylinder of oxygen in addition to the generator and is equipped with handles and large wheels, making it readily portable.

"Rubber-Mounted" Toggle Switch

A TOTALLY enclosed, toggle-type flush switch with rubber-mounted mechanism designed especially for quiet operation has been announced by Cutler-Hammer, Inc., 190 12th Street, Milwaukee, Wis. The mechanism, which is mounted directly upon two soft rubber pads,



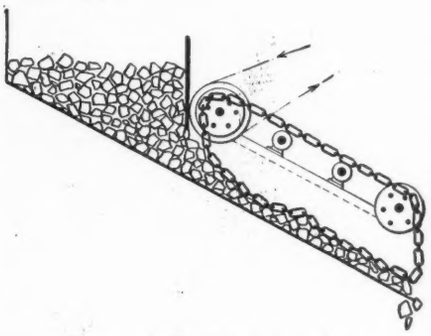
Rubber mounted switch

has non-stubbing contacts and compression-type lubricated spring. The switch is made in single and double pole, three- and four-way types, with standard mounting throughout.

Chain Feeder for Coal and Lump Material

ONE of the difficulties in discharging coal or other lump material from bins by means of chutes is the inaccuracy in the control of the operation. To obviate this trouble the Ross Feeder illustrated was developed in England and is now being introduced in this country by the Ross Screen & Feeder Company, 247 Park Ave., New York City. This feeder makes it possible to use a large chute opening and at the same time to control the flow of feed within close limits.

The feeder consists of a curtain of heavy, endless steel chains driven by an overhead tumbler and suspended in front of the chute opening so as to lie on the material and to travel with it for a considerable distance. The accuracy of control is said to be within 2 per cent on a tonnage basis. Several other variations of the principle have been worked out wherein the feeder may be used in connection with chutes of variable angle, chutes which are equipped with grizzly bars for screening out the fines, and various other types.



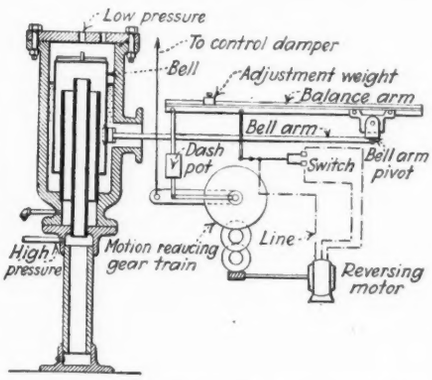
Ross chain feed in chute

Volume-Flow Regulator

A NEW volume-flow regulator for air and gas adaptable to a number of services is announced by the Brooke Engineering Company, 1321 Arch St., Philadelphia, Pa. The machine is designed for an initial pressure of 100 lb., with a maximum allowable variation of 2 per cent.

The regulator consists essentially of a heavy casting containing a bell in an oil seal. The vertical movement of the bell is mechanically magnified by means of a long arm pivoted at the right. The shaft extends from this pivot through a stuffing box and is connected to the balance arm, which is calibrated in units of 0.1 of water.

Movement of the balance arm is communicated to a set of electrical contacts, which cause a small motor



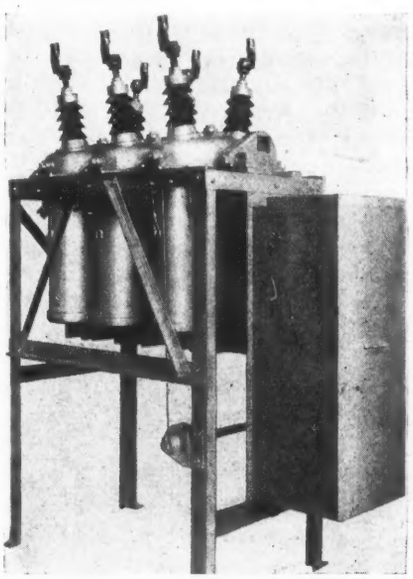
Schematic drawing of flow regulator

to run either forward or backward. The motor drives through high-reduction train an operating arm, which is connected to the valve or damper to be controlled. Compensation is provided by an oil dashpot. Movement of a small sliding weight placed on the balance arm permits immediate change from one operating differential to another.

Moderate-Capacity Oil Circuit Breaker

THE ABILITY to locate the breaker-control, such as hand-operated, face-plate solenoid, or motor mechanism, in any one of six positions is a feature of the new line of outdoor-circuit breakers (type 0-2) recently introduced by the Condit Electrical Manufacturing Corporation, Boston, Mass.

Designed for use on distribution services at 15,000, 25,000 and 37,000 volts in capacities of 400, 600 and 800 amperes, the breaker has heavy laminated brushes protected on closing and opening by unusually large arcing contacts. One-piece porcelain bushings extend below the oil line and are securely clamped to the top. Provision is made for two-bushing type current transformers per pole, and



Breaker erected with operating mechanism

series-type current transformers can be mounted inside of the breaker tank if desired. The tanks are elliptical in shape and of welded heavy-gage steel.

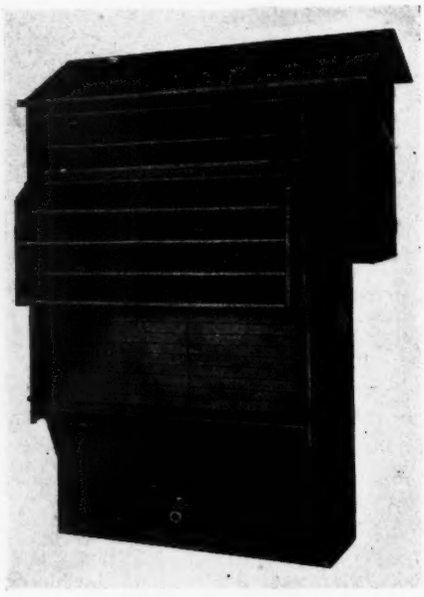
The breakers are manually or electrically operated (alternating current or direct current). The electrically operated breakers may be arranged for automatic service on one or more closing cycles with constant power or varying time delay.

CHILLED IRON CASTINGS manufactured by the Fuller Lehigh Company, of Fullerton, Pa., will hereafter be known as Elverite. The name is derived from that of J. S. Elverson.

Multi-Panel Air Filter

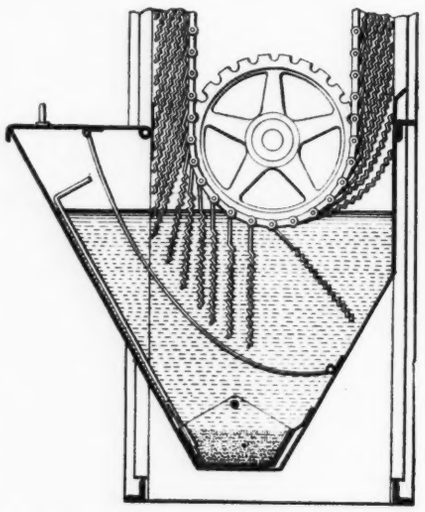
AN outstanding feature of the improved multi-panel air filter, put out by the Reed Air Filter Company, Louisville, Ky., is the method of separating the panels and cleaning each one individually as it passes through the oil reservoir at the bottom of the filter stand. Although developed originally to meet the severe operating conditions and exacting air-cleaning requirements of steel mill service, the filter is adaptable to a wide range of industrial applications. By virtue of its design and method of cleaning, the operating resistance is constant.

The filtering media consists of a multiplicity of overlapping screen panels that form a continuous moveable curtain. To increase the capillary surface effect these panels are coated with liquid bakelite covered with fine fiber and baked in an oven. This forms a porous fibrous coating capable of retaining many times the amount of adhesive that normally would be held on the smooth surface of the bare wire. Naturally the greater the amount of the adhesive oil that the filter media can carry, without danger of entrainment, the greater will be the dust-holding capacity of the filter and the longer it will operate without loss of efficiency.



Multipanel air filter equipped with weather housing for outside installation, showing free access to the oil reservoir

The panels, which are suspended from horizontal rods carried by two endless chains, overlap each other like shingles on a roof, forming a filtering curtain with a depth of five panels at every point through which the air must pass. The average resistance through the filter is 0.36 in. water gage. The woven wire used for these filtering panels is folded upon itself to give double thickness and double strength. The panels are corrugated horizontally to secure the desired spacing between successive layers, to supply additional voids for dust accumulation and to provide increased filtering area.



Section through lower part of filter, showing panels separating at the lower turn and swinging through oil reservoir

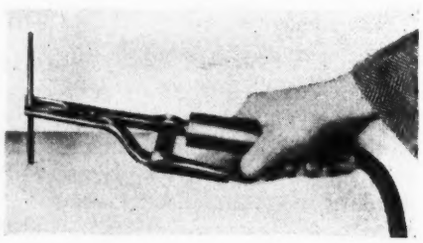
The filter curtain operated by a solenoid and ratchet mechanism, in steel-mill service, and by a hydraulic drive in ventilating installations, moves $\frac{3}{4}$ in. every 12 min. or $3\frac{3}{4}$ in. an hour. Under severe dust conditions the speed may be increased to maintain a normal operating resistance.

At the top the sprockets carrying the filtering curtain are keyed to the shaft, at one end of which is the drive and on the other end a pin coupling for connecting two or more filter sections in large installations. The lower shaft is mounted on spring take-up bearings to maintain the proper tension on the filtering curtain.

As the panels reach the lower turn they automatically separate and are cleaned, one at a time, by swinging in the oil through an arc of 90 deg. This action loosens and removes the dust accumulation. While in the oil bath the panels hang vertically, permitting the dirt to settle to the bottom of the reservoir, where it is deposited into the sediment pan. The panels leave the oil vertically, being moved up $\frac{3}{4}$ in. at a time with a 12-minute interval for draining. This action tends to strip off any surplus oil. Each panel drains a total of $1\frac{1}{2}$ hours after leaving the oil before it enters the air stream. Being heavier than the oil, the dust and dirt washed from the panels settle to the bottom of the reservoir in the form of sludge. To concentrate this sludge the sides of the reservoir are sloped, and a pan in the bottom receives the deposits. For convenience in removing this pan, removable handles extend above the oil level.

These filters are made in sizes ranging from 5 to 13 ft. high and in capacities based on an average air velocity of 500 ft. per min., ranging from 3,000 to 84,000 cubic feet per minute.

A filter of similar construction, with additional reinforcing to withstand the pulsating air flow to compressor and engine services, also is made by the company. Capacities of this filter range from 1,500 to 24,000 cubic feet per minute.



Holder will grip electrode at any angle

Light Metal-Electrode Holder

A LIGHT metal electrode holder suitable for all commercial sizes of arc-welding electrodes up to and including $\frac{1}{4}$ in. in diameter has been added to the line of welding equipment put out by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The jaws are made of pressed-metal and will grip the electrode in any position or at any angle. The close distance between the lower jaw and the upper handle allows the device to be used in close quarters. The holder is furnished with or without five feet of flexible cable, and it weighs approximately eighteen ounces without the cable.

For light carbon electrode welding or cutting an adapter which handles $\frac{3}{8}$- and $\frac{1}{2}$-in. carbon rods can be obtained.

RECENT PUBLICATIONS

POWER RESOURCES OF THE WORLD: An estimate of the total energy available in the world from coal, gas, oil, waterpower and electric power. Compiled by Hugh Quigley for the International Executive Council, World Power Conference. Published by the Country Press, Bradford, England. 7x5 in.; 170 pages. Price, $4.50 if obtained through the American Committee, World Power Conference, Washington, D. C.

ONE of the greatest weaknesses of the large amount of information on world power resources presented at the First World Power Conference, 1924, held in London, and at the International Economic Conference of 1927, at Geneva, was the fact that no standard method of investigation had been adopted. The task of reconsidering differences of standpoint and of treatment seemed to be insuperable. It was felt by the international executive council, however, that until this great initial difficulty was overcome, little real progress could be made in the formation of a reliable estimate of the world's power resources. The results of this survey, under the supervision of Hugh Quigley, appear in this book on world power resources.

No attempt is made to estimate the total energy available in the world from all sources other than to quote the estimate of Professor Svante Arrhenius made in 1922. The present study is confined to the world power derived from rivers, from coal, from oil and from the air. The various estimates of power available through these sources are taken up in comparative detail.

In summarizing the various world resources, the world power production in 1927 is given on three bases: coal, calories, and electrical units. Using coal as a basis, the total world power production in 1927 is given as 1,655.8 millions of tons, the American continent leading, with 822.2 millions of tons. The same world quantity based on calories is given as 9,960 thousands of millions, and in electrical units as 1,655,800 millions of kilowatt-hours.

The executive council makes several constructive suggestions looking to a more comprehensive and exact study of world power resources, emphasizing especially the non-uniformity of basic units such as horsepower, etc. The committee feels that other sources of power of an organic nature, such as timber, vegetable products and peat, should not, for the present, be surveyed by the World Power Conference, but does earnestly recommend that an effort be made to issue monthly statistics of electrical output from the main power committees, and also annual statistics for the principal countries of the world.

The book closes with an exhaustive bibliography of the works on world power resources by nations.

THE ENGINEERING INDEX FOR 1928. Published by the American Society of Mechanical Engineers, 29 West 39th Street, New York City, 1929. Two volumes; cloth; 7¾x10½ in.; approximately 2,000 pages. Price, $125.

IN THIS encyclopedic bibliography of periodical literature are listed more than 75,000 reference items to articles that have appeared in 1,700 domestic and foreign magazines during 1928. Each article is so described that the reader quickly secures an adequate conception regarding its probable value for his purpose. The book covers every branch of the engineering field, and subjects have been classified under 5,000 separate headings by technically trained experts. The 1928 index contains several new features, including a more generous use of "see also" cross-references, a complete list of the publications reviewed, with place and frequency of issue, and an author index that lists the writers of all articles.

COAL IN 1927: Mineral Resources of the United States, 1927; Part II, Pages 327 to 509. Compiled by the Bureau of Mines, Department of Commerce. Published by the United States Government Printing Office, Washington, D. C., 1929. Price 30 cents.

A COMPREHENSIVE statistical study of coal production in the United States, by states and districts. Information is also included showing the main headings under which coal is used. According to a chart in this book railroads use 27.7 per cent of all bituminous coal consumed, industry uses 41 per cent, electric utilities 7.7 per cent, gas works 1 per cent, and the remainder is used for domestic and miscellaneous purposes. These and many other useful facts are contained in a work of great interest to all concerned in the production, marketing and use of coal.

DISCHARGE CHARACTERISTICS OF SUBMERGED JETS. By M. J. Zucrow. Bulletin No. 31, Engineering Experiment Station, Purdue University, Lafayette, Ind. 1928. Paper, 6x9 in.; 69 pages.

IT IS SHOWN in this bulletin that the discharge characteristics of submerged short tubes or jets may be investigated by experimenting with one liquid, one typical jet and an adequate range of heads. From the dimensional plotting of the results so obtained, the discharge characteristics of geometrically similar jets can be deduced. The experiments were conducted with small-bore square-edge and chamfered jets, chemically pure benzol being used as the liquid. Application of the results to carburetor jets is described.

ENGINEERING EXPERIMENT STATION RECORD SUMMARY. Edited by R. A. Seaton. Published by the Engineering Experiment Station Committee, Association of Land-Grant Colleges and Universities; R. A. Seaton, Kansas State Agricultural College, Manhattan, Kan., secretary. Paper; 6x9 in.; 98 pages. Price, $1.

THIS publication is a complete summary of the great amount of engineering research that has been carried on in land-grant colleges from Maine to California. Carefully prepared data on the administration, organization, funds, employees, live research projects, channels of publication, and bulletins and circulars issued at each of the 38 definitely organized experiment stations are contained in the summary. While many of the 1,263 engineering research bulletins listed in this summary and already issued by these stations are primarily for the use of research workers in the engineering field, many of the titles listed will be of decided interest to those engaged in actual engineering practice. The fact, as shown in the summary, that a total of $1,440,018 is available for engineering research in these institutions in 1928-29, indicates that the research being carried on is of too great an extent to be disregarded by the progressive engineer.

TAIWAN (Formosa): Its System of Communications and Transportation. Published by the Governor General of Taiwan. Submitted by the Japanese Delegate for Taiwan to the Ninth Conference of the International Postal Union, London, May, 1929. Boards; 6½ x 9½ in.; 50 pages; illustrated.

WHILE this book deals in general with the postal, telegraph, railway and highway systems of the island of Formosa, it contains a statement of the status of power developments. This is of particular interest, because one of the few large hydro-electric plants in Asia, that at Lake Candidius, is now under way there. This will provide about 100,000-kw., developed at 1,080 ft. head.

"THE STORY OF UNITED STATES MOTORS," an attractive 45-page bulletin lately issued by the United States Electrical Manufacturing Company, of Los Angeles, gives a step-by-step picture of the design and construction of the patented "asbestos-protected" electric motors manufactured by this company. Beginning with a short history of the company, and a description of the modern plant of over five acres in which the motors are built, the bulletin illustrates the various factory operations. A section is devoted to a visual explanation of the special features of the motors and to a description of the patented asbestonite insulation. Full-page illustrations of the standard types of United States motors and several cross-section views are also included.

FROM AMONG READERS' PROBLEMS

Conducted by L. H. MORRISON

SAVING FROM HIGHER TEMPERATURE OF FEED WATER—*Where the boiler pressure is 120 lb. gage, what is the percentage of saving from returning the condensation from heating coils to the boiler at 240 deg. by traps in place of returning the water to a tank and feeding the water at 180 deg. F.?* G. R.

In either case each pound of feed water, when converted to steam at 120 lb. gage, or 135 lb. per sq.in. absolute, would contain 1191.6 B.t.u. above 32 deg. F. When the feed temperature is 180 deg. F., then each pound of feed water for conversion into steam would have to receive $(1191.6 + 32) - 180 = 1043.6$ B.t.u.; and when the feed temperature is 240 deg. F., each pound of the feed water would have to receive $(1191.6 + 32) - 240 = 983.6$ B.t.u., or $(1043.6 - 983.6) \times 100 \div 1043.6 = 5.75$ per cent. more heat. Whether this represents the actual saving of coal from use of the traps, in place of a receiving tank and feed pump, depends on the relative steam economies of the trap or feed pump that may be employed.

RETURN TRAP CONNECTION—*We are installing some machinery that requires a supply of live steam and will have return traps for returning the condensation to the boiler, carrying 85 lb. pressure. One of the machines is to be supplied with steam reduced to the pressure of 30 lb. gage. How should the returns and trap be arranged and connected?* F. K.

All returns connected to a trap or receiver should be at the same pressure; otherwise those of higher pressure will prevent the trap from simultaneously receiving returns of lower pressure. Systems of returns that are at different pressures will require separate traps. The return pipes should be sloped so they will be drained perfectly clear of condensation and discharged by gravity to the trap with the trap placed four feet or more above the water line of the boiler. It is well to place an automatic air valve on the return line near the trap and also provide a pet-cock for testing whether the returns are being emptied. When the trap becomes filled with return water, the mechanism automatically admits live steam from the boiler for siphoning the water into the boiler, but cannot do so unless the receiver is elevated sufficiently for obtaining the necessary head of discharge water for overcoming friction of the trap discharge pipe and fittings. There should be a separate return connection to the boiler, with check valve or connection so arranged that the discharge will not be affected by pulsations of a boiler-feed pump. The inlets and outlets for admission and discharge of return water, and for admission of live steam and discharge of displacing steam, are usually described in directions issued by the manufacturer or are indicated on the trap. If the water inlet of the trap is not provided with a check valve, one should be placed in the return line near the trap. Most return traps are provided with a small outlet for discharge of the displacement steam. This should be provided with a stop valve and pipe and intended for portable use.

LOCOMOBILE ENGINE—*Why is the locomobile steam engine and boiler unit so economical?* M. M.

There is no doubt that the high economies are due to the precautions taken in their design to guard against initial condensation and to minimize loss of heat in the flue gases and the exhaust steam. The more economical plants are operated compound condensing. Steam generated in the boiler is passed through a superheater suspended in the smoke box with the direction of steam flow so arranged that the hottest steam is heated by the hottest gases. The steam then passes through a pipe within the flue to the high-pressure cylinder, which is jacketed by the hot flue gases. From the high-pressure cylinder the steam passes to a reheater receiver contained in the smoke box and is thence admitted to the low-pressure cylinder, exhausting through a feed-water heater to the atmosphere or to a condenser. The boiler-feed pump, and condenser pump if used, are driven directly from the main engine.

STEAM TO CYLINDER.—*If an engine has a quarter cutoff in each end of the cylinder, do both ends take the same amount of steam?* L. L. C.

Usually cutoff is stated in terms of "apparent" cutoff, and when the engine is said to have a quarter cutoff, actually the steam valve covers the part when the piston is one-quarter along its stroke.

If we call the stroke volume V, then the steam in the cylinder end at cutoff is $\frac{V}{4}$ plus the steam filling the clearance space, which we will call C. The total steam is then $\frac{V}{4} + C$ for the head end.

For the crank end we must deduct the space B occupied by the piston rod, so that on the crank end the steam volume at cutoff is $\frac{V}{4} + C\text{-}B$. Obviously, the head end totals more steam, than the crank end.

CARBON TEST—*What is the "carbon test" used in examining Diesel fuel oils?* M. R. B.

The principle of the carbon residuum test is dependent upon the fact that there is a certain amount of carbon in all oils, which can be "fixed" by distilling a definite quantity under certain conditions.

In commercial oils of different bases, the carbon residue increases nearly in proportion to the increase in viscosity. It is lowest in the very light oils.

The apparatus for making a Conradson carbon residue test consists of a porcelain crucible within a Skidmore iron crucible, having a cover with one opening, within a wrought iron crucible with a cover. Sand is placed in the bottom of the wrought iron crucible to bring the Skidmore crucible nearly flush with the top of the wrought iron crucible. This is supported on a triangle, over a flame, and a sheet iron or an asbestos head, with a chimney, is put on the crucible to distribute the heat uniformly. Ten grams of the oil to be tested are placed in the porcelain crucible and heat is applied intensely, until oil vapors begin to ignite over the crucible, and then the heat is increased until the oil vapor flame comes off at a uniform rate. After the vapor ceases to come off the heat is again increased, making the lower part of the iron crucible red hot, and it is maintained in that condition for five minutes. The heat is then shut off and the porcelain crucibles cooled in a desiccator, weighed, and the percentage of residue by weight thus obtained.

The carbon residue test is important in connection with lubricating oils for use in the cylinders of internal combustion engines, although the test does not actually indicate the relative amount of carbon deposit which will occur in the oil when used in the explosion chamber walls of such engines or which will appear in the form of carbon sediment.

HIGH PRESSURE SURFACE HEATER.—*What is a high-pressure surface heater?* C. M. B.

In plants where the turbine is bled at one or several pressures to heat the feed water, a surface heater is installed into which the steam coming from the bleeder line is mixed directly with the feed water.

PREVIOUS QUESTION

Discussed by Readers

THE QUESTION

WE HAVE three pulverized-lignite-fired boilers in our power plant and are endeavoring to keep a record of the hours during which each boiler is in operation, unavailable, banked or idle. As a result, two questions have come up:

1. *When is a pulverized-fuel-fired boiler "banked"?*

2. *What, if anything, do the terms "live bank" and "dead bank" mean?*

A PULVERIZED-fuel-fired boiler is considered banked when the fuel feed is entirely cut off, hence when the fire is out. The period of banking lasts until the feeders are again started and the fire again lighted.

A "live bank" means the banking of a boiler, but using intermittent firing, usually two burners, to hold the boiler pressure within 50 lb. of the header pressure.

A "dead bank" means the banking of a boiler and allowing the boiler to cool, pressure dropping, until the boiler is to be brought back on the line. The duration of time that no fuel is fed to the boiler is the period of the dead bank.

C. G. Krause,
Comal Power Plant
San Antonio Public Service Co.
New Braunfels, Texas.

—❖—

A PULVERIZED-fuel-fired boiler is not banked in the sense that is ordinarily understood when the term is applied to stoker- or hand-fired boilers.

However, such a boiler may be said to approach a banked condition when the fuel and air supply is shut off after a steaming run and the dampers are tightly closed to prevent any air from passing through the furnace and boiler setting. In this way the only heat loss involved during banking hours is that due to radiation from the boiler setting. Ordinarily, this loss is so small that the boiler steam pressure will drop only a few pounds during a banking period of several hours.

With no circulation of air through the furnace, the temperature remains high during the banking period, and when the boiler is needed for service, the use of a center burner for a few minutes will bring the boiler up to header pressure again.

The term "live bank" is used with reference to stoker-fired boilers to indicate that a small fire is kept burning briskly enough to keep the boiler "floating" on the header without generating any appreciable amount of steam. With a pulverized-fuel boiler the same condition may be obtained by using one burner for a very short period of time, at intervals of about half an hour.

The term "dead bank" is used when a bed of green coal of about twice the ordinary fuel-bed thickness is run in to cover about one-third of the grate surface. The dampers are opened only enough to prevent gases escaping through the setting into the boiler room. The boiler pressure is allowed to drop below the header pressure. The bank is not broken up until a short time before the boiler is needed for service.

Peter G. Dahl,
Assistant Boiler Room Engineer,
Crawford Ave. Station,
Commonwealth Edison Co.
Chicago, Ill.

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THE WRITER has had no experience with lignite-fired boilers, but has had with bituminous-fired boilers equipped with unit attrition-type pulverizers and air-cooled walls.

There can be no such terms applied to powdered-fuel operation as "live bank" or "dead bank." However, the term "banked" may be so applied to a "reserved boiler" held in readiness with about 100 lb. steam pressure, utilizing the heat from the walls.

As an emergency this method can be applied to unit pulverizers directly connected to each boiler without cross-over fuel connections. The pressure is maintained on the night shifts, and it takes from 15 to 20 min. and about 500 lb. of fuel to accomplish the so-called "banked" operation.

My experience has been that in case of an emergency steam can be more quickly raised to the operating pressure than it would be ordinarily with a cold boiler. I have had no experience in the nature of breakdowns, nor do I contemplate any.

I use a schedule sheet of boiler-room operation, showing a daily record of boiler or boilers in service, reserved or out of service for cleaning, etc., indicating number of hours and minutes and amount of coal consumed in each particular operation. Thereby a complete record is maintained weekly, monthly and yearly. A record is also kept of the number of hours of each pulverizer and boiler alteration.

Our plant is equipped with four unit attrition-type mills and three boilers fired with bituminous coal; the fourth pulverizer, recently installed, is interconnected and arranged to feed any of the three boilers in case of an emergency. This arrangement insures flexibility of boiler operation and, incidentally, eliminates the "reserved-boiler" operation termed "banked," thereby making a considerable saving in fuel, which, in a comparatively short time, will pay for the additional pulverizer and changes made in the boiler room.

P. Dias,
Plant Engineer,
Essex County Hall of Records.
Newark, N. J.

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PULVERIZED-FUEL boilers are ordinarily considered "banked" when the fuel feed is stopped and the stack damper, forced-draft dampers, and burner vanes are closed, if this be possible without injury to the burners, in the effort to preserve heat stored in the furnace brick work.

The amount of heat storage depends, of course, on the furnace wall design. Furnaces with refractory surfaces store much more heat than do those with almost entirely water- and steam-cooled walls. A large pulverized-coal boiler with three cold faces in the furnace, boiler tubes, rear wall and bottom water screen, had a drop in steam pressure from 310 to 265 lb. during a five-hour "bank." It required only 1,300 lb. of coal to put the boiler back on the line.

On the other hand, design may be such that too good a "bank" is not advisable. Radiant heat stored in the furnace may damage the fuel burners or radiant-superheater elements if there is little or no air flowing.

A "live-banked" pulverized-fuel boiler is usually one that is actually on the line but at a very low output. For example, in a plant with eight boilers where six of these are required to carry the evening peak it might be found best to operate all six through the night at a low load on each, that is, "live-banked," instead of taking off three. In other words, stand-by losses would exceed low-rating operating losses, and it would be more economical to operate all than to bank part and raise the remainder to higher ratings.

A "dead-banked" boiler is one in which the fuel feed is actually stopped.

Topeka, Kan. R. H. Sogard.

A Question For Our Readers

ASSUMING that a boiler is operating at 400 lb., will the feed pump do more work if the feedwater heater is placed between the boiler and the pump than if the pump is between the boiler and heater, assuming that the feed water is raised to 300 deg. F. from a hotwell temperature of 100 deg. F.?

Suitable answers (of 200 words or less) from readers will be paid for and published in the Sept. 17 issue.

Hydrogen Ion Concentration Is Vital Factor in Corrosion Control

Four factors, hydrogen ion concentration, deaëration, hardness and temperature, complicate the corrosion problem. They are so inter-related that generalizations are impossible

THE significance of hydrogen ion concentration as a factor influencing the corrosive properties of boiler feed water was pointed out by J. R. McDermet, of the Elliott Company, of Jeanette, Pa., in a paper presented at the convention of the American Water Works Association held recently at Toronto, Canada.

Hydrogen ion concentration, which is merely a delicate measure of the active acidity or the alkalinity of the water, not only has a direct influence upon the rate of corrosion, but affects to a considerable extent the efficiencies of various water purification processes.

Neutral water, which has a pH value of 7.0 (10^{-7} grams of ionized hydrogen per liter), offers few difficulties to the complete elimination of corrosion, at least at temperatures below 550 deg. F., according to the report. Above this temperature, dissociation of the water itself changes the pH value and makes normally neutral water distinctly acid.

Water that is acid in character, hence badly corrosive, has a pH value lower than 7.0. With any waters having a pH value greater than 6.0 it has been found possible to afford useful if not complete corrosion protection.

It has been known for considerable time that lime-bearing waters are less corrosive than waters free from lime. This is due to the fact that waters containing lime are usually alkaline on the pH scale, that is, have a value above 7.0.

With waters whose pH value is greater than 7.5, according to Mr. McDermet, a reduction of dissolved oxygen to less than 0.5 c.c. per liter by deaëration will give complete control of corrosion. Both hydrogen ion concentration and deaëration processes are often complicated in ordinary practice by the necessity for water softening. All three of these factors are so interrelated, so far as their effects upon corrosion is concerned, that generalizations as to the effect of altering any one cannot be made. The problem is further complicated when temperature changes come into play.

"It is possible," the paper points out, "to deaërate a lime-soda-softened water either by hot or cold process methods with complete success in corrosion prevention." This is because the softening process leaves the water with a high pH value, that is, quite alkaline, and because the deaëration will remove, in addition to the oxygen, all of the free carbon dioxide and a good portion of that which is combined.

With zeolite-softened waters, difficulties in which carbon dioxide plays an important part arise. As a result, treatment of these waters is not established with the satisfaction characteristic of other waters. It is pointed out, however, that zeolite softening is usually applied to waters that are originally more difficult to handle from the corrosion standpoint, and which, in fact, could be handled no better by the lime-soda process. Thus the advantages and disadvantages of zeolite more or less counterbalance. It is possible to provide immunity to corrosion with such waters by "deaëration in combination with a pH value not less than 9.5," according to Mr. McDermet.

Deactivation, the process in which scrap iron is purposely rusted in order to exhaust the water of its dissolved oxygen, is also greatly affected by hydrogen ion concentration. Ordinarily the iron compounds formed are apt to become colloidal and coagulate with difficulty. If the pH value is kept above 9.3, the granular form of these compounds is produced and they can be satisfactorily separated.

A coagulant to control artificially the pH value has been developed to solve this problem, says the report. Calcined and partially sintered magnesium carbonate, which has a solubility that is approximately proportional to the requirements of the water, has, to some degree at least, solved the problem of precipitating the troublesome iron salts from the deactivated water.

Effective Stack Gas Purification

THE PERFECT chimney, from which nothing could emerge but clean, pure and harmless gases, is an ideal capable of realization if the smoke nuisance be given the attention it deserves. This is the gist of an editorial appearing in a recent issue of *The Engineer* (London). One of the persistent problems of a civilized community the editorial goes on to say, is to dispose, inoffensively, of waste products.

The technique of the disposal of sewage and of various kinds of trade wastes has been intensively studied, because any offenses are patent to the world. It is not so with chimney gases, which are invisible and in dilution practically odorless. That these waste products of combustion are, or may be, a nuisance is only now coming to be generally recognized, and engineers are faced with the problem of rendering them as inoffensive as the air into which they are discharged.

Fortunately, the article points out, there is not the slightest objection to the matter which a chimney must necessarily emit; approximately 80 per cent of it is pure nitrogen, and fresh air contains almost exactly this same proportion. If we add to this about 8 per cent of pure oxygen and 12 per cent of pure carbon dioxide, we have roughly the composition of the whole of the necessary flue gases, neglecting the amount of water vapor accompanying them.

Such nuisance as a chimney may create does not therefore lie at the door of what may be called the pure flue gases. It consists entirely in the discharge of comparatively very small quantities of extraneous matter in the form of soot, tarry vapors, grit, and sulphurous fumes. It is these that have to be prevented, surely and continuously, from escaping in order to render chimneys free from reproach.

Much has been done to overcome the smoke evil by improvement of furnace conditions, and substantial progress has been made with regard to the elimination of grit. Few engineers, however, would be willing to guarantee the absolute smokelessness of their chimneys during the next 24 hours, in view of the necessity of soot blowing and the inevitable variations in furnace operation. Fewer still would like to guarantee that their waste gases were free from grit, especially with forced draft, inferior fuel and heavy loads.

Even then, the problem of ridding the gases of compounds of sulphur would still stand in the way of the perfect chimney. It might even be advisable, the editorial states, to pass the gases over some cheap material which the sulphur compounds could combine and so prevent their action on buildings and vegetation.

If it be found that no solution to the problem, short of washing the whole of the products of combustion, can be developed, then this eventuality will have to be faced.

Another possibility for the removal of sulphur compounds is developed in the editorial. If moisture condensing within economizers and air heaters absorbs the sulphurous fumes and converts them into weak sulphuric acid, thus causing corrosion, would it not be possible to convert this vice into a virtue by deliberately causing this action to take place in properly designed equipment? If the whole of the gases were cooled to a temperature below the dewpoint, it would seem probable that all the sulphur could be eliminated as sulphuric acid and afterwards be converted into an inert and harmless sulphate by contact with limestone.

The fact remains, however, that our ideal for the perfect chimney can hardly be satisfactorily attained by these piecemeal improvements. A simple, dependable and inexpensive process which could remove not only sulphur compounds but also all the soot, grit and tarry fumes as well would make the sun shine brighter within the power house as well as in the sky.

Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE

*Spot * News*

AS A RESULT *of conferences between Secretary of Interior Wilbur, Commissioner of Reclamation Mead and power companies in the Southwest, it is practically certain the Federal Government will build the power plant to be constructed at Boulder Dam. The government has received assurances that it will realize enough from the sale of power to pay the entire cost of the project in fifty years.*

* * *

A MEMORANDUM *has come to the attention of the Federal Power Commission indicating that its accounting practice will be sharply attacked by utility companies. These efforts to change the attitude of the commission will be investigated, according to plans announced by Senator Couzens.*

* * *

JULY SALES *of mechanical stokers, as reported to the Department of Commerce by the ten leading manufacturers in the industry, amounted to* 186 *of* 65,197 *hp., as compared with* 186 *of* 58,670 hp. *in July,* 1928. *The total for the first seven months in* 1929 *is* 998 *of* 358,418 *horsepower.*

* * *

CONSTRUCTION *is progressing on a* $10,000,000 *dam near Bingham, Me., for the Central Maine Power Company. When completed the dam will be* 2,810 *ft. long and the generating equipment will consist of three units developing a total of* 103,000 *horsepower.*

* * *

CULMINATING *lengthy efforts by the Electric Bond & Share Company of New York to acquire the power, light and traction properties of the Brazilian Traction, Light & Power Company, Ltd., a satisfactory agreement for the purchase of the South American company has been reached.*

* * *

PRESIDENT HOOVER *announced on Aug.* 13 *that the Federal Government would co-operate with the State of California in planning a policy for the coordinated development of the State's water-power resources.*

Rapid Welding Progress Revealed by A. W. S. Fall Meeting Program

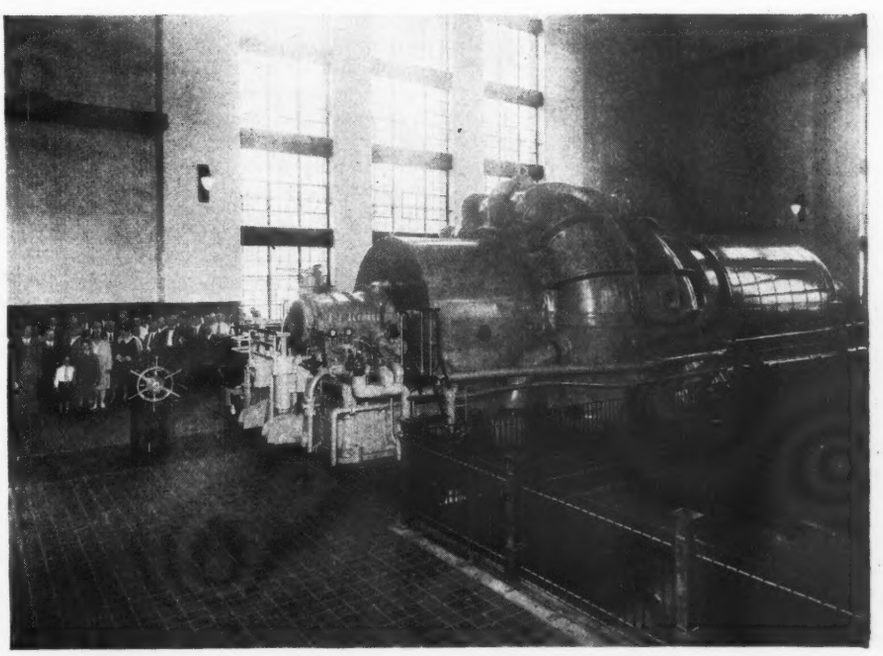
CONTINUED rapid expansion of welding applications, backed by extensive research activities, is revealed in the preliminary distribution of the fall meeting program by the American Welding Society. This meeting is to be held in Cleveland, Ohio, Sept. 9 to 13, with morning sessions at the Hotel Statler and afternoon sessions and extensive exhibits at the Cleveland Public Auditorium.

Because of the mass of important material available it has been necessary to increase the technical sessions to six this year and to allow more time for reports of important research projects. No less than nine research papers will be presented, three of them dealing with newly-discovered non-destructive tests of welds. One of these tests, based on electrical conductivity, is the discovery of Elmer Sperry, well-known inventor and president of the American Society of Mechanical Engineers. The second involves the use of the stethescope and the third makes use of X-ray methods.

Other research papers cover "nitrogen needles," electric welding by the carbon and metallic arcs, special metallographic studies, stress-strain characteristics of welded joints and the use of X-rays in examining welds.

Two papers will deal with the welding of boiler tubes and drums, the tubes of mercury boilers, etc. Other subjects covered by technical papers include gas welding of steel buildings, automatic welding of thin sheets, welding of pipe lines, replacement of castings by welding in machine construction, and the welding of copper alloys and high-strength aluminum alloys.

In addition to the nine research papers three special sessions will be devoted to research. A meeting of the bureau of welding will deal with a variety of research projects. The meeting of the structural steel welding committee will record advances in that fast-developing field. A special conference of college professors and other research workers will be called to discuss weld-



TURBINE-GENERATOR NO. 11 went into service Aug. 1 at Delray power house No. 3 of the Detroit Edison Company's system. The new 50,000-kw. unit was started up for its preliminary tests on July 15 with a fitting ceremony in which the daughter of Alex Dow transferred to the new power plant the original Delray fire that was started in 1904 and has never been allowed to go out since.

Happy faces indicate the Universal Craftsmen enjoyed their recent convention

ing research and further the co-ordination of activity along this line.

Those attending the A.W.S. fall meeting may profit also by the sessions of the American Society for Steel Treating, the Iron and Steel Division of the American Institute of Mining and Metallurgical Engineers, the Institute of Metals Division of the American Society of Mechanical Engineers, which are meeting simultaneously in Cleveland during the week of Sept. 9. The co-operation of these groups makes possible a great exposition in the Cleveland Public Auditorium, where more than 275 manufacturers will show the latest equipment, supplies and methods for the manufacture, working, treating, welding and use of every kind of metal. More than 80,000 sq.ft. of floor space will be covered by these exhibits.

Five Hydro-Electric Engineers Needed by Government

The United States Civil Service Commission announces the following open competitive examinations:

Principal hydro-electric engineer, $5,600 to $6,400; senior hydro-electric engineer, $3,200 to $3,700; hydro-electric engineer, $3,800 to $4,400; associate hydro-electric engineer, $3,200 to $3,700, and assistant hydro-electric engineer, $2,600 to $3,100 a year.

Applications for these positions must be on file with the Civil Service Commission at Washington, D. C., not later than Sept. 18. The examinations are to fill vacancies occurring in the Engineering Department at large, War Department, throughout the United States, and in positions requiring similar qualifications.

Competitors will not be required to report for examination at any place, but will be rated on their education, training, experience and fitness. Full information may be obtained from the United States Civil Service Commission, Washington, D. C.

Universal Craftsmen's Council Holds Well-Attended Meeting in Detroit

THE 27th annual meeting of the Grand Council of the Universal Craftsmen's Council of Engineers held at the Book-Cadillac Hotel, Detroit, Aug. 5-9, brought together 225 delegates representing 63 councils extending from Springfield, Mass., to Los Angeles, and from Vancouver, B. C., to Dallas, Texas. There were, in addition, 125 delegates to the ladies' council, and a considerable number of supply men and other guests. A very creditable exhibition of power-plant apparatus and supplies was held in one of the ballrooms of the hotel.

Monday the 5th was devoted to the registration and reunion of the delegates and visitors, with a reception and dance in the Crystal Ballroom in the evening.

The meeting of the grand council was called to order at 10 a.m. on Tuesday by Deputy Grand Chief M. C. Schwenk, who introduced Charles W. Draper, chairman of the convention committee and past chief of the local council. After an invocation by the Rev. Calvin F. Stickles the attendants upon the convention were welcomed by Dr. Phillip A. Callahan, member of the Detroit City Council and the City of the Straights Council 39, and by the Rt. W. George W. Graves, P.G.M., State of Michigan. These remarks were fittingly responded to by Mr. Draper; John R. Haas, G.W.C., U.C.C. of E., and Sarah E. Aldridge, G.W.P. of the ladies' council.

Business sessions were held Tuesday afternoon, and each succeeding forenoon. On Wednesday afternoon the party was taken to the Ford airport, where the photograph reproduced herewith was taken. Thursday afternoon was devoted to a visit to the New Masonic Temple, and on Friday evening there was a banquet, followed by a moonlight excursion on the Detroit River. Features of the evening's entertainment were songs by Joe McKenna, of Jenkins Brothers, and moving pictures taken during the convention by George Ogden, of the C. E. Squires Company. Besides their participation in these events special entertainment was provided for the ladies.

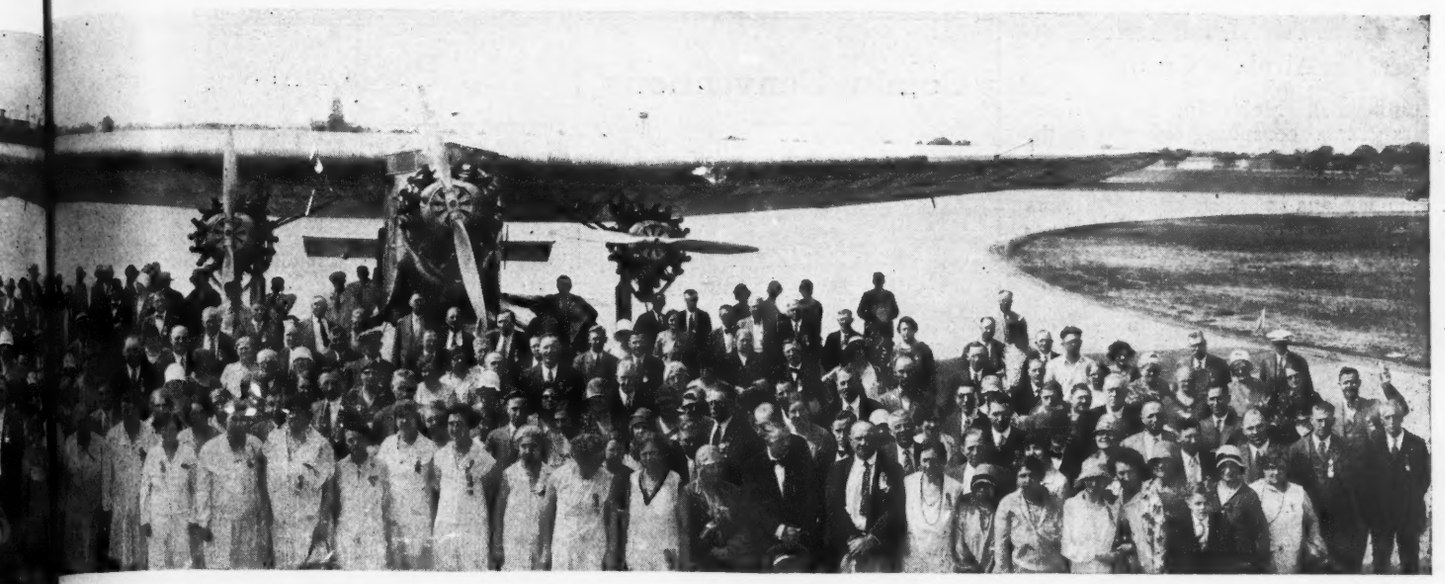
The election resulted in the selection of the following officers for the ensuing year: Grand worthy chief, George A. Lambert, Brooklyn; grand assistant chief, William T. Wardell, Chicago; grand warden, A. C. Elder, Los Angeles; grand chaplain, Milton W. Meekins, Baltimore; grand guard, Charles F. Kuechele, Washington; senior trustee, Paul D. Hutton, Buffalo; second trustee, A. L. Barnes, Milwaukee; junior trustee, Joseph Patton, Newark; secretary, Thomas H. Jones, Cherrydale, Va., and treasurer, John L. O'Brien, Chicago.

The invitation of Springfield, Mass., to entertain the next convention on condition that the exhibition feature be eliminated was accepted.

Construction Cost to Determine Project Value, Commission Rules

Construction cost alone will determine the value of hydro-electric power projects in the eyes of the Federal Power Commission, according to an opinion rendered last week by Charles A. Russell, solicitor of the commission. In determining the "actual, legitimate cost of construction" under the Federal water power act, "lump sum or percentage overheads for engineering, supervision, management, financing, development, etc. must not be included in capital expenditures," the memorandum states.

The opinion, which hinged in great measure upon the legal distinction be-



Many delegates inspected the Ford airport, where this photograph was taken

tween "cost of construction" and "costs of construction" in the wording of the act, limits the valuation strictly to the actual expenditures of money or its equivalent. Even before the pay of executives and general officers can be included, they must be "engaged exclusively" in the construction work, it is pointed out.

Solicitor Russell maintained, however, that no general rule could be made that would cover every project, and that each case must stand on its own facts. He pointed out that under the law the prelicense cost of projects must be determined. It was also pointed out that the accounting rules of the Power Commission are practically identical with those of the Interstate Commerce Commission.

Two cases which illustrated this interpretation of the statute were ruled upon recently by Mr. Russell. In the case of the Cumberland Falls power project in Kentucky, an item of $250,000 for stock issued to the Middle West Utilities Company and the Hydro-Electric Power Company by the Cumberland River Power Company should be eliminated, according to the memorandum, because "this was a development of the Middle West Utilities Company property from its very inception" and the inclusion of this item "is an attempt to arbitrarily add to the capital account a sum of money which is clearly outside the provisions of the water power act."

Mr. Russell also rejected the inclusion of $250,000 involved in the contract with the Kentucky State Park Commission. This sum was to be paid by the Cumberland Hydro-Electric Power Company to the park commission for the creation of a state park in the vicinity of Cumberland Falls and the construction of roads in that area.

Both of the decisions are certain to be challenged. The Federal Power Commission itself has not acted upon the opinions and will not have opportunity to do so until the next meeting, late in September.

Brooklyn "Boiler Explosion" Compressed Air Tank Collapse

Early newspaper reports to the effect that an explosion occurring in the macaroni factory of A. Zeregas, Inc., Brooklyn, N. Y., on Aug. 8, was caused by a failure of the boilers were controverted by the investigation of the New York Police Boiler Squad. Instead, it was found that the compressor cylinder head and two compressed-air tanks had blown out under a pressure of 3,500 lb. The boilers, which were being used only to supply hot water and therefore had no pressure on them, were intact. Compressed air, it was said, was used to blow the holes in the macaroni.

Severe damage resulted from the explosion. Two men were killed, one was critically injured and seventeen were hurt. The first floor over the engine and boiler room collapsed, and a serious fire resulted which partly destroyed the six upper floors. The middle section of the building's wall was blown into the street at the first story, and flames fed by flour dust licked up the face of the building to its full height. Most of the injuries sustained by workers were due to flying débris.

North Carolina Power Project to Rival Niagara Falls

A "New Niagara" is being planned in the mountains of North Carolina and Tennessee by the Aluminum Company of America, which will spend $125,000,000 in the development of hydro-electric projects. Through eight separate dams electric power exceeding in magnitude the energy now generated by Niagara Falls will be created. Seven of the eight projects will be in western North Carolina and the other in Tennessee. The projects, in their totality, represent what is said to be one of the largest and most ambitious power developments in the United States, and will require seven years to execute.

Recent formation of the Natahala Power & Light Company, with principal offices at Bryson City, N. C., and an authorized capital stock of $10,000,000, is declared to be a step in the plans of the aluminum company. The lakes caused by damming streams will wipe out the towns of Almond, Bushnell, Judson, Wesser, Forney's Creek, Eppes Springs and several smaller villages, it is said. The cost of relocating railroads and highways is given as $1,700,000.

The Aluminum Company of America acquired its first power site in western North Carolina in 1905. Two plants are now in operation and a third is under construction. The first step in the extensive plans for development of the "New Niagara" will be construction of a plant at Fontana, on the Tennessee River. Two others are planned at Bushnell, near the junction of the Tennessee and Tuckasegee Rivers, one at Needmore and one at Acqueon.

Puget Sound Company to Develop Project on Columbia River

W. H. McGrath, vice-president of the Puget Sound Power & Light Company, Seattle, recently announced tentative plans for a huge power development on the Columbia River at Rock Island near Wenatchee, which ultimately may cost $20,000,000. Some of the details were made public when the Federal Power Commission granted a preliminary permit for the project. Mr. McGrath explained that it was planned to spend $12,000,000 on the first unit, which would supply 60,000 kw., and that an additional outlay of $8,000,000 would increase the output to 180,000 kw. The plan is to distribute some of the power to central Washington, but to carry most of it over the Cascades into western Washington, where there is an increasing power demand.

L. B. McMillan Killed in Airplane Crash

Luther B. McMillan, for thirteen years general consulting engineer of the Johns-Manville Corporation, died Aug. 10 as a result of injuries sustained when the monoplane in which he and William De Roberts were riding went into a nose dive and crashed to the ground. He was 38 years old.

Mr. McMillan was born at Bem, Mo., Sept. 21, 1891. He was graduated from the Texas Agricultural and Mechanical

Luther B. McMillan

College in 1911 with the degree of Bachelor of Science in mechanical engineering. He later took graduate work in mechanical engineering and chemical engineering at this institution and was instructor in mechanical engineering in 1912 and 1913. He received the degree of Mechanical Engineer in 1912 and of Chemical Engineer in 1913.

He was awarded a fellowship in engineering at the College of Engineers of the University of Wisconsin for 1913-14 and received the degree of Master of Science in 1914. After serving two years as instructor in steam and gas engineering at this institution and specializing in research pertaining to the science of heat transmission, with particular attention to heat transfer through insulation, he became general consulting engineer for the Johns-Manville Corporation.

Mr. McMillan was a member of the American Society of Mechanical Engineers, American Society of Heating and Ventilating Engineers and the American Society of Refrigerating Engineers, and he belonged to the Engineers Club, Western Universities Club, and the Texas Agricultural and Mechanical College Club of New York.

Always a very active member of the A.S.M.E., he served on many important committees and was a member of the council at the time of his death. His research work on heat insulation was notable. In 1916 he received the A.S.M.E. junior award for a paper entitled "The Heat Insulating Properties of Commercial Steam Pipe Covering."

Due to his standing in his profession he was prominently identified with the National Research Council. From 1924 to 1928 he served on the subcommittee on heat transfer, and in 1928 when the Division of Engineering and Industrial Research authorized the organization of the committee on heat transmission he was elected a member of the executive committee and also appointed chairman of the subcommittees on thermal insulation.

His services for the Johns-Manville Corporation constituted a record of marked achievement in the insulation field. Always searching for improved methods, he had to his credit the development of many important insulating materials and improvements in their manufacture and application. The thermal insulation testing laboratory of the corporation at its Manville factory, regarded as one of the most completely equipped private laboratories in the United States for investigation work pertaining to all classes of insulating materials, was established under Mr. McMillan's direction.

Coming Conventions

American Institute of Electrical Engineers. Pacific Coast Regional Meeting, Santa Monica, Calif. Sept. 3-6. District meeting at Chicago, Ill., Dec. 2-4. Annual winter convention at New York, N. Y., Jan. 27-31, 1930. F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Society of Mechanical Engineers. Annual meeting at New York, N. Y., Dec. 2-6. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Society of Heating & Ventilation Engineers. Annual meeting in Philadelphia, Pa., Jan. 27-30, 1930, at the Benjamin Franklin Hotel. Secretary, A. V. Hutchinson, 33 W. 39th St., New York City.

American Welding Society. Fall meeting at Cleveland, Ohio, Sept. 9-13. Secretary, M. M. Kelly, 33 West 39th St., New York City.

National Association of Power Engineers, 47th annual convention, Chattanooga, Tenn., Sept. 9-13. Fred Raven, secretary, 417 South Dearborn St., Chicago, Ill.

National Association of Practical Refrigerating Engineers. Twentieth annual convention at the William Penn Hotel, Pittsburgh, Pa., Nov. 4-7. Secretary, E. H. Fox, 5707 W. Lake St., Chicago, Ill.

National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York City, Dec. 2-7. Charles F. Roth, manager, Grand Central Palace, New York City.

New England Water Works Association. Annual convention at Hotel Eastland, Portland, Me., Sept. 17-20. Secretary, Frank J. Gifford, 715 Tremont Temple, Boston, Mass.

Third National Fuels Meeting at the Bellevue-Stratford Hotel, Philadelphia, Pa., Oct. 7-11.

World Engineering Conference, Tokyo, Japan, October, 1929. All correspondence should be addressed to the Secretary, World Engineering Conference, Nikon, Kogyo Club, Morunouchi, Tokyo.

PERSONALS

FRANK M. GENTRY, formerly assistant to the mechanical engineer, New York Edison Company, and for many years principal assistant engineer with George A. Orrok, consulting engineer, has resigned from the New York Edison Company to join the staff of Lehman Brothers, bankers, 1 William St., New York City.

HUBER O. CROFT, formerly associate professor of mechanical engineering at Stanford University, has been appointed head of the mechanical engineering department at the University of Iowa.

EDGAR JADWIN, major-general in the U. S. Army, retired as chief of the army engineers on Aug. 12. General Jadwin was in close touch with the work of the Federal Power Commission. His successor has not been named as yet.

DANIEL TORRANCE, formerly secretary to A. W. Leonard, president, Puget Sound Power & Light Company, Seattle, has been made assistant to the president. Mr. Torrance has been associated with the Stone & Webster interests for fifteen years and went from Boston to Seattle about four years ago to take the position of assistant comptroller of the Puget Sound Power & Light Company.

J. F. GASKILL, power engineer with the Philadelphia Electric Company, has been appointed chairman of the technical committee of the American Institute of Electrical Engineers on general power applications. Other appointments were F. A. ALLNER, general superintendent of the Pennsylvania Water & Power Company, Baltimore, Md., as chairman of the committee on power generation, and H. R. WOODROW, electrical engineer with the Brooklyn Edison Company, as chairman of the committee on power transmission and distribution.

F. R. GEORGE, formerly engineer of operation for the Pacific Gas & Electric Company, San Francisco, has been made engineer of electrical operation and maintenance, and O. W. Peterson continues as engineer of general construction. Both report direct to P. M. Downing, formerly vice-president in charge of electrical operation and construction but now vice-president and general manager.

HAROLD SMITH, general solicitor of the Westinghouse Electric & Manufacturing Company, has been elected vice-president of the company. He entered the legal department of Westinghouse in 1919 and was appointed general solicitor in 1926.

Business Notes

Merco Nordstrom Valve Company, Oakland, Calif., has recently completed enlargements to its plant which double the amount of manufacturing space available. Special engineering quarters have been incorporated in the addition. The original plant was erected only two years ago and at the time was believed to be large enough for several years to come.

Chain Belt Company, Milwaukee, Wis., announces that Robert B. Marshall, for two years connected with the conveyor business, has joined its sales organization.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., have recently purchased a 22-acre site in Newark, N. J., for a new warehouse and service station. It is planned that this new shop will serve the entire northern New Jersey industrial area.

Pittsburgh Valve, Foundry & Construction Company, Pittsburgh, Pa., announces the appointment of W. H. Arnold as general sales manager, succeeding C. A. Anderson, Jr., who became president of the company a short time ago. Mr. Arnold has been with company since 1905.

Wagner Electric Corporation, St. Louis, Mo., has moved its Cleveland service station and branch sales office to a new building, at 3756 Carnegie Ave.

American Hoist & Derrick Company, St. Paul, Minn., announces the opening of a branch office at 5800 Bingham Ave., Detroit, Mich. G. J. Heck, sales representative in that district, will be in charge.

Allen-Bradley Company, Milwaukee, Wis., has appointed the Ward Engineering Company, Inc., Barnett National Bank Building, Jacksonville, Fla., as its representative for the Jacksonville territory. R. E. Ward, who heads the engineering company, previously represented the Allen-Bradley Company in Cincinnati, Ohio.

Jeffery Manufacturing Company, Columbus, Ohio, announces that C. W. Miller has resigned as treasurer. H. Supp, Jr., formerly credit manager, has been elected treasurer to succeed Mr. Miller. Mr. Supp has also been elected treasurer of the Ohio Malleable Iron Company, a subsidiary of the Jeffery company. W. A. Grieves has been elected secretary of the Malleable Iron Company and J. F. Davidson elected to the board of directors.

Hahn Engineering Company, Lancaster, Pa., has recently appointed the following sales agencies: Neville & Cleary, Atlanta, Ga., and Garrett Burgess, Inc., Detroit, Mich.

Trade Catalogs

Boilers—Description of the low-head water-tube boilers for power and heating purposes manufactured by the D. Connelly Boiler Company, Cleveland, Ohio, is contained in its bulletin No. L.H. 50. Principles of operation, construction details and distinctive features are given concerning these boilers, which are suitable for medium and small industrial plants, hotels, schools, laundries, etc., especially where ceiling height is limited.

Pumps—Bulletin D-45 B-1, recently issued by the Worthington Pump & Machinery Corporation, Harrison, N. J., describes the "Axiflo," "Hiflo" and "Coniflo" deep-well pumps manufactured by that company. Besides describing the construction and application of these pumps, the bulletin contains tables on flow of water through pipes, horsepower required to raise water, and other useful engineering data. A description of Worthington gasoline meters for filling station pumps is contained in Bulletin W-900 B-1, another recent publication of the Worthington Company.

Electrical Devices—Bulletins recently issued by the General Electric Company, Schnectady, N. Y., include the following: Accessories for Switchboards, GEA-938A; Current-Limiting Resistors and Fusible Cutouts, GEA-1047; Arc Welder, Single Operator, GEA-876C; High-Speed Circuit Breakers, GEA-520A; Recording Instruments, Types CD and CDP, GEA-1061A.

Motors—Description of the new ARZ motor, designed by the Allis-Chalmers Manufacturing Company to offer the advantages of the open-type motor while at the same time remaining suitable for use in locations exposed to dirt, acids, fumes, etc., is contained in Leaflet 2109. Illustrations of the constructional details of the motor, as well as several photographs showing it in use under severe operating conditions, are included.

Feed Water Treatment—Bulletin 20, published by the National Aluminate Corporation, 6216 West 66th Place, Chicago, Ill., tells of the various types of "Nalco" chemical proportioners for the automatic feeding of chemical reagents. Bulletin 21 is a paper by J. A. Holmes pointing out the relation between the control of boiler water concentration and foaming, carryover, and wet steam.

Transmission—Two bulletins describing the "Texrope" drive have been released by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis. Bulletin 1228-J gives a view of the uses of this system of mechanical transmission in industry. Over fifty illustrations of "Texrope"-drive installations are shown. Bulletin 1241-A describes the use of the drives in theaters, hospitals, etc., for ventilating purposes where a noiseless drive is essential.

Superheaters — The Superheater Company, 17 East 42nd St., New York City, gives a complete description of the "Elesco" multiple-loop, single-pass superheater in Bulletin T-19, which it has recently released. The various designs suitable for use with boilers of different types are described and illustrated.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard	New York	$2.10 @ $2.35
Kanawha	Columbus	1.25 @ 1.55
Smokeless	Cincinnati	1.85 @ 2.00
Smokeless	Chicago	1.75 @ 2.00
S. E. Kentucky	Chicago	1.15 @ 1.60
Steam	Pittsburgh	1.40 @ 1.75
Gas Slack	Pittsburgh	1.00 @ 1.10
Big Seam	Birmingham	1.50 @ 1.75
Anthracite (Gross Tons)		
Buckwheat	New York	$2.65@$2.75
Barley	New York	1.40@ 1.50

FUEL OIL

New York—Aug. 15, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.75c. per gal.; 36@40 deg., furnace, tank-car lots, 6c. per gal.

St. Louis—Aug. 13, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.4209 per bbl. or 42 gal.; 26@28 deg., $1.4709 per bbl.; 28@30 deg., $1.5209 per bbl.; 30@32 deg., $1.5709 per bbl.; 32@36 deg., gas oil, 4.276c. per gal.; 38@40 deg., distillate, 5.23c.

Pittsburgh—Aug. 13, f.o.b. local refinery, 30@34 deg., fuel oil, 4.5c. per gal.; 36@40 deg., 5c. per gal.

Philadelphia — Aug. 6, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 22 deg. plus, $1.575@$1.625 per bbl.; 23@27 deg., $2.10@$2.15 per bbl.

Cincinnati—Aug. 13, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5.25c. per gal.; 30@32 deg., 5.5c. per gal.

Chicago—Aug. 9, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 65c. per bbl.; 26@30 deg., 85c. per bbl.; 30@32 deg., $1.00 per bbl.

Boston—Aug. 12, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.35c. per gal. 28@32 deg., 5.42c. per gal.

Dallas—Aug. 10, f.o.b. local refinery, 26@30 deg., $1.30 per bbl. or 42 gallons.

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Whittier—City plans an election to vote $310,000 bonds for waterworks improvements including new wells, pumping plants, etc. M. R. Bowen, is city engineer.

D. C., Washington—D. C. Commissioners, will receive bids until Aug. 22 for remodeling power plant at Gallinger Hospital.

Ga., West Point—J. Smith Lanier has been granted permit to construct a hydro-electric plant and two dams on Chattahoochee River, 100,000 hp. capacity near here. Estimated cost approximately $10,500,000 McDonald & Co., Southwestern Trust Bldg., Atlanta, are engineers. Hardaway Contracting Co., First National Bank Bldg., Columbus, awarded contract on cost plus percentage basis.

Ill., Springfield—City, J. E. Smith, Mayor, will receive bids until Aug. 26 for the construction of an automatic sub-station. Burns & McDonnell Engineering Co., 402 Interstate Bldg., Kansas City, Mo., is engineer.

Ind., Knightstown—Indiana Soldiers & Sailors Orphans Home, L. A. Cortner, Supt., will receive bids about Nov. 1 for the construction of a power house including equipment. Estimated cost $200,000. McGuire & Shook, 941 North Meridian St., Indianapolis, are architects.

Mass., Hopkinton — Water Commissioners, Town Hall, will build a pumping station, etc. in connection with waterworks. Hydraulic Development Co., 296 Boylston St., Boston, is engineer. Work will be done by separate contracts.

Mass., New Bedford—S. Kaplan, 841 South Water St., awarded contract for the construction of a coal handling plant and coal pockets on Brook St. to O. Saulniers & Son, 12 Scott St.

Mass., West Springfield (Springfield P.O.)—Strathmore Paper Co., Mittineague, will soon award contract for the construction of a hydro-electric plant. Estimated cost $40,000. L. R. Howe, c/o owner, is engineer.

Mich., Battle Creek—Consumers Power Co., Jackson, awarded contract for the design and construction of a 25 x 52 ft. power house including two 400 hp. vertical boilers, ash handling equipment, coal bunker and equipment, etc., on Main St., here, to Stevens & Wood, Consumers Bldg., Jackson. Estimated cost $40,000.

Mich., St. Clair—City will soon award contract for waterworks improvements including well, filtration plant, two low lift service pumps, etc. Pate, Bacon & Hamann, 922 Transportation Bldg., Detroit, are engineers.

Mich., Flint—New Orleans Fruit Co., Water and Harrison Sts., awarded contract for the construction of a 2 story cold storage plant to Spence Bros., Saginaw. Estimated cost $150,000.

Mich., Flint—Smith, Hinchman & Grylls, 800 Marquette Bldg., Detroit, Archts., will receive bids until Aug. 30 for the construction of a 15 story bank and office building including steam heating and ventilation systems, boilers, elevators, etc. on South Saginaw St. for Union Industrial Trust & Savings Bank, Flint. Estimated cost $1,000,000.

Mich., Lansing—City, c/o O. E. Eckert, Gen. Mgr., awarded contract for a 125 x 150 ft. addition to power house at River Park to H. G. Christman Co., Porter Apartment Bldg. Estimated cost $750,000.

Mo., Savannah—City is having plans prepared for the construction of a municipal electric light plant. Burns & McDonnell, 400 Interstate Bldg., Kansas City, are engineers.

New Jersey—Delaware, Lackawanna & Western R.R. Co., Hoboken Terminal, Hoboken, is receiving bids for the construction of two electric sub-stations, one at Newark and one at Denville. Estimated cost $40,000 each. G. J. Ray, Hoboken, is chief engineer.

N. J., Pinewald—Sangor Hotel Corp., B. H. Sangor, Pres., 60 Park Pl., Newark, is receiving bids for the construction of an 8 story hotel including steam heating, ventilation and refrigeration systems, boilers, elevators, etc. at Crystal Lake Shore here. Estimated cost $1,000,000. W. K. Oltar-Jevsky, 130 West 42nd St., New York, N. Y., is architect. Former bids rejected.

N. Y., Buffalo—Bd. of Managers, Buffalo City Hospital, received lowest bid for the construction of a group of buildings including nurses' home, power plant, etc. at 462 Grider St. from Mosier & Summers, Seneca St.

O., Apple Creek—Dept. of Welfare, H. H. Griswald, Dir., Ninth and Oak Sts., Columbus, awarded contract for the construction of a group of buildings, including power house, etc., for Institution for Feeble Minded, to R. H. Evans Co., Atlas Bldg., Columbus.

Okla., Tecumseh—City plans an election Aug. 20, to vote $120,000 bonds for waterworks improvements, including dam, filtration plant, pump house, mains, etc.

Ore., Baker—City plans water supply and municipal power plant improvements. Stevens & Koon, Spalding Bldg., Portland, are consulting engineers.

Ore., Hood River — City is having preliminary plans prepared for the construction of a municipal power plant. Estimated cost $750,000. Stevens & Koon, Spalding Bldg., Portland, are consulting engineers.

Pa., Philadelphia—Quaker City Laundry, 48th and Locust Sts., awarded contract for the construction of a 50 x 100 laundry and power house at 4808-12 Market St. to A. R. Raff, 1635 Thompson St.

Tex., Brackettville — City plans an election Sept. 3 to vote $60,000 bonds for waterworks improvements including pumping equipment, etc.

Tex., Marshall—City plans an election Aug. 24 to vote $25,000 bonds for waterworks improvements including pumping equipment, mains, etc. Hawley & Freese, Frost Bldg., San Antonio, are engineers.

Tex., Mercedes—Central Power & Light Co., Frost Bldg., San Antonio, will soon award contract for the construction of a 150 ton ice plant here. Estimated cost $60,000. J. M. Marriott, Frost Bldg., San Antonio, is architect.

Tex., Port Arthur—Gulf States Utilities Co., 362 Liberty St., Beaumont, will build a power substation. Estimated cost $225,000. Work will be done by owners forces.

Tex., San Antonio—U. S. Government, War Dept., A. W. Parker, Constructing Quartermaster, will receive bids until Aug. 29 for heating plants for six barracks buildings; refrigeration plant for Quartermaster's warehouse; boiler heating units, etc., $340,000.

Wash., Longview—Washington Gas & Electric Co., Washington C. H., Ohio, is having preliminary plans prepared for a new water supply system, including filtration plant, pumping plant, etc. Estimated cost $300,000. Stevens & Koon, Spalding Bldg., Portland, Ore., are consulting engineers.

Ont., Lucknow—Village plans extensions and improvements to waterworks system including sinking two wells, deep well pumps, etc.

Ont., Ottawa—Dept. of Public Works, S. E. O'Brien, Secy., will receive bids until Aug. 23 for addition to central heating plant.

Equipment Wanted

Air Compressor—Lake County Gas Co., Willoughby, O., is in the market for a power driven air compressor.

Cables and Potheads—W. J. Spaulding, Comr. of Public Property, Springfield, Ill., will receive bids until Aug. 26 for cables, pothead and conduit for automatic substation.

Oil Burning Equipment—U. S. Veterans Bureau, Arlington Bldg., Washington, D. C., will receive bids until Aug. 27 for fuel oil burning equipment at U. S. Veterans' Hospital, Walla Walla, Wash.

Pumping Equipment — City of Erie, Pa., pumping equipment, etc., for proposed waterworks. Estimated cost $700,000.

Pumping Equipment—City of Park Rapids, Minn., pumping equipment, etc., for proposed waterworks. Estimated cost $20,000.

Pumping Unit—City of Bay City, Mich., will receive bids until Sept. 12 for one 6,950 g.p.m. steam turbine driven geared centrifugal pumping unit complete with accessories.

Pumping Units—City of Bellingham, Wash., is receiving bids for two pumping units for proposed waterworks at Sunset Heights. Estimated cost $47,000.

Pumps—City of Columbia, S. C., will receive bids until Aug. 27 for 2 to 3½ m.g. horizontal piston pumps against 310 ft. head.

Pumps—City of Clio, Mich., motor driven centrifugal pumps, etc. for proposed waterworks improvements.

Pumps and Equipment—City of Wyandotte, Mich., motor driven centrifugal pumps and equipment for proposed sewage pumping station. Estimated cost $250,000.

Pumps and Motors—City of Minco, Okla., plans to purchase two triplex pumps and motors for proposed waterworks system.

Turbine, Governor and Accessories—Dept. of Public Works, Supplies & Tenders Committee, Wellington, N. Z., will receive bids until Oct. 29 for one turbine, governor and accessories, also main valve and accessories, spares, etc.

Industrial Projects

Calif., Berkeley — STEEL AIRCRAFT FACTORY—Neilsen Steel Aircraft Co., Second and Camelia Sts., is having plans prepared for a 2 story, 60 x 200 ft. addition to factory. Private plans.

Calif., San Francisco — METER REPAIR PLANT, etc.—Pacific Gas & Electric Co., 245 Market St., is having plans prepared for the construction of a meter repair plant, garage, etc., at Folsom, Shotwell, 18th and 19th Sts. Estimated total cost $1,000,000.

Calif., San Francisco—CLEANING PLANT ADDITION—Thomas Cleaning & Dyeing Co., 27 10th St., awarded contract for a 4 story cleaning plant on Mission St. to H. L. Peterson, 163 Sutter St. Estimated cost $150,000.

Conn., Stamford—FACTORY—Pitney-Downes Postage Meter Co., Pacific St., is having plans prepared for a 2 story, 60 x 300 ft., factory Estimated cost $150,000. Fletcher Thompson Inc., 542 Fairfield Ave., Bridgeport, is architect.

Mass., Athol — TWIST DRILL FACTORY — Union Twist Drill Co., 70 Munroe St., awarded contract for a 2 story, 60 x 105 ft., addition to factory to E. J. Cross Co., 82 Foster St., Worcester. Estimated cost $60,000.

Mich., Kalamazoo—AUTOMOBILE FACTORY —Checker Cab Co., is having plans prepared for the construction of a 2 story, 320 x 520 ft. automobile factory. A. Kahn, 1000 Marquette Bldg., Detroit, is architect. Electric motors, etc. will be required.

Minn., Leroy — FIBER PLANT — Minnesota Fiber Co., will build a 40 x 140 x 60 ft. plant for handling flax fiber by breaker process, including boiler and engine plant. Estimated cost $30,000.

N. J., Kearny—FACTORY—Western Electric Co., 195 Broadway, New York, will receive bids about Oct. 1 for the construction of 4 or 5 new buildings as additions to plant here. Estimated cost $3,000,000 to $4,000,000. Foundations awarded to Frederick Snare, 114 Liberty St., New York.

O., Cleveland—FACTORY—Whiteway Stamping Co., H. S. Whiteway, Pres., 1201 East 55th St., awarded contract for a 1 story factory on East 70th St. to Boldt-Rapp Co., 6007 Euclid Ave. Estimated cost $50,000.

Tex., Baytown—OIL REFINERY—Humble Oil & Refining Co., Humble Bldg., Houston, plans the construction of 400 x 600 ft. oil refinery, here. Estimated cost $2,000,000.

Tex., Natalia—CERAMIC PLANT—San Antonio Suburban Irrigated Farms, c/o C. H. Kearny, Frost Bldg., San Antonio, is receiving bids for unit 1 of ceramic plant, also plans units 2 and 3 near here, for the manufacture of hollow, roofing, drainage and other tiles. Estimated cost $150,000 and $250,000 respectively.

Ont., Preston — FURNITURE FACTORY — Canadian Office & School Furniture Co. Ltd., 1195 King St., awarded contract for a 4 story, 70 x 93 ft. furniture factory to Oscar Weber, Lancaster St., Kitchener. Estimated cost $75,000.

Ont., St. Catharines—AUTOMOBILE FACTORY—McKinnin Industries, Div. of General Motors Co. of Canada, H. J. Carmichael, Mgr., will soon award contract for first unit of factory, 1 story, 120 x 480 ft. on Ontario St. Estimated cost $175,000. Private plans. Equipment for the manufacture of automobile equipment and specialties will be required.

Ont., Toronto—STEEL FABRICATING SHOP —Hamilton Bridge Works Ltd., Bay St. N., plans the construction of a steel fabricating shop at ft. of Spadina Ave. Estimated cost $250,000. Electrically driven machinery including shears, drills, presses, riveters, forges, etc. will be required.

Ont., Toronto—PAINT FACTORY—Sherwin-Williams Co. Ltd., 1 Leslie St., plans the construction of a 3 or 4 story paint factory. Estimated cost $200,000. Ross & McDonald, 1 Belmont St., Montreal, Que., are architects.

Sask., Exanse—SALT WORKS and POWER PLANT—Bishopric & Lent Salt Works, plans the construction of a factory and power house. Estimated cost $500,000. Prices, etc., on new equipment.

PRICES - MATERIALS - SUPPLIES

Electrical prices on following page are to the power plant by jobbers in the larger buying centers east of the Mississippi. Elsewhere the prices will be modified by increased freight charges and by local conditions.

SINCE LAST MONTH

THE market is remarkably stable. This is true of prices generally. Despite tremendous activity in the iron and steel industry throughout the year, prices have not fluctuated. The only change of recent date was a 10c. drop in the price of blue annealed and galvanized sheets. Copper sales have been increasing steadily through the month, with the other non-ferrous metals quiet, and prices steady. Bituminous coal prices in July were about the same as in June, but are lowest for that month in the last five or six years. Industrial buying is backward and is expected to start this month or next.

POWER-PLANT SUPPLIES

HOSE—Quotations at New York warehouses:

	Fire Protection	50-Ft. Lengths
Underwriters' 2½-in., coupled, single jacket		(net) 60c. per ft.
Common, 2½-in., cotton, rubber-lined, 80c. per ft., list, less		50%
	Air—Best grade	
¾-in., per ft	3-ply....$0.30	4 ply....$0.36
	Steam—Discounts from List	
First grade....40%	Second grade.....45%	Third grade....50-10%

RUBBER BELTING—List price 6-in., 6 ply, $1.83 per lin.ft. The following discounts from list apply to rubber transmission belting:

Best grade.....50% Second grade.....60%

LEATHER BELTING—List price, 24c. per lin.ft., per inch of width, for single ply, at New York warehouses:

Grade	Discount from list
Medium	30-10%
Heavy	30%

RAWHIDE LACING—For cut, best grade, 30-5%; 2nd grade, 45-5%. For laces in sides, best, 57c. per sq.ft.; 2nd, 52c., net. Semi-tanned, cut, 30-5%.

PACKING—Prices per pound at New York warehouses:

Rubber and duck for low-pressure steam, ⅛ in	$0.90
Asbestos for high-pressure steam, ⅛ in	1.75
Duck and rubber for piston packing	.90
Flax, regular	1.15
Flax, waterproofed	1.70
Compressed asbestos sheet	.85
Wire insertion asbestos sheet	1.20
Rubber sheet	.45
Rubber sheet, wire insertion	.75
Rubber sheet, duck insertion	.55
Asbestos packing, twisted or braided and graphited, for valve stems and stuffing boxes	1.40
Asbestos wick, ½- and 1-lb. balls	.50

PIPE AND BOILER COVERING—Discounts from list at New York warehouses are as follows:

85% magnesia, high pressure		50%
Asbestos, air cell, for low-pressure heating and return lines	4-ply	70%
	3-ply	72%
	2-ply	74%

PORTLAND CEMENT—New York, $2.25 per bbl., without bags, delivered by truck to site of job. Bag charge, 40c. per bbl.

STRUCTURAL STEEL—New York delivered price, beams and channels, 3 to 15-in.; angles, 3 to 6-in., ¼-in. thick; tees, 3-in. and larger; and plates, ¼-in. thick and heavier; all $3.30 per 100 lb. in lots up to 3,999 lb.

COTTON WASTE—The following prices are in cents per lb., at warehouse:

	New York	Cleveland	Chicago
White	10.00@13.50	16.00	15.00
Colored	9.00@13.00	12.00	12.00

WIPING CLOTHS—Prices per pound in lots of about 600 lb., for washed white wipers, as follows:

Chicago (100 lb. bales)	$0.16
New York (100 lb. bales)	.16
Cleveland (per thousand)	38.00

LINSEED OIL—These prices are for raw oil in barrels, f.o.b., in 1 to 4 bbl. lots:

	New York	Cleveland	Chicago
Per pound	$0.136	$0.11	$0.137

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b., New York:

	Dry	In Oil
Red	$13.75	$15.25
White	13.75	13.75

RIVETS—The following quotations apply on fair-sized orders from warehouse:

Tank rivets, $\frac{1}{16}$-in. diameter and smaller, list (Apr. 1, 1927) less 60% in full packages, for immediate delivery from warehouse stocks in New York and vicinity.

Structural rivets, ½-in., round head, per 100 lb.:

New York	$4.50*
Chicago	4.00
Pittsburgh mill	3.10

*Price is for full packages; broken package lots are $6.00 net, delivered.

REFRACTORIES—Prices in car-loads, f.o.b. plant:

Chrome brick, eastern shipping points	per net ton	$45.00
Chrome cement, 40@50%, Cr_2O_3, in bulk	per net ton	22@25
Chrome cement, 40@50%, Cr_2O_3, in sacks	per net ton	26@29
Magnesite brick, 9-in. straights	per net ton	65.00
Magnesite brick, 9-in. arches, wedges and keys	per net ton	71.50
Magnesite brick, soaps and splits	per net ton	91.00
Silica brick, Mt. Union, Pa	per M	43.00
Clay brick, 1st quality, 9-in. shapes, Pennsylvania	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Ohio	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Kentucky	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Maryland	per M	43@46
Clay brick, 2nd quality, 9 in. shapes, Pennsylvania	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Ohio	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Kentucky	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Maryland	per M	35@38
Chrome ore crude, 40@50%	per net ton	18.00@22.50

BABBITT METAL—Delivered, New York, cents per lb.:

Genuine, highest grade	65.00
Commercial genuine, intermediate grade	48.00
Anti-friction metal, general service	31.50
No. 4 babbitt (f.o.b.)	12.00

COLD DRAWN STEEL—Shafting and screw stock, warehouse prices per 100 lb., base, are as follows:

	New York	Cleveland	Chicago
Round or hexagon	$3.50	$3.65	$3.60
Flat or square	4.00	4.15	4.10

BOILER FITTINGS—F.o.b. warehouse, Jersey City, N. J., discounts from list:

Copper ferrules	70%
Boiler flanges	65–5%
Boiler stay bolts	60%
Boiler patch bolts	20%
Boiler fitting-up bolts	45%
Pressed steel boiler lugs	10%

WROUGHT PIPE—The following basing discounts from list are for large mil lots at Pittsburgh mill:

BUTT WELD

	Steel			Iron	
Inches	Black	Galv.	Inches	Black	Galv.
1 to 3	62%	50½%	1 and 1¼	31%	15%

LAP WELD

2	55%	43½%	2	23%	9%
2½ to 6	59%	47½%	2½ to 3½	28%	13%
7 and 8	56%	43½%	4 to 6	30%	17%
9 and 10	54%	41½%	7 and 8	29%	16%
11 and 12	53%	40½%	9 to 12	26%	11%

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60%	49½%	1 to 2	34%	18%
2 and 3	61%	50½%			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53%	42½%	2	29%	13%
2½ to 4	57%	46½%	2½ to 4	34%	20%
4½ to 6	56%	45½%	4½ to 6	33%	19%
7 and 8	52%	39½%	7 and 8	31%	17%
9 and 11	45%	32½%	9 to 12	21%	8%
11 and 12	44%	31½%			

BOILER TUBES—Following are net prices per 100 ft. at New York warehouses on tubes manufactured according to specifications of the American Society of Mechanical Engineers:

Size	Lapweld Steel	C. C. Iron	Seamless Steel
1	.....	.....	$17.07
1¼	.....	.....	19.20
1½	.....	$38.00	17.92
1¾	.....	28.50	20.48
2	$17.33	25.00	20.24
2¼	19.84	28.25	23.00
2½	21.60	34.00	26.03
3	25.50	42.50	27.04
3¼	30.25	49.50	30.67
3½	31.50	52.75	33.33
4	38.03	67.00	40.11

These prices are net, per 100 ft., based on stock lengths. If cut to special lengths, billing will be based on the entire stock lengths.

In addition to the above, standard cutting charges are as follows:

2 in. and smaller	5c. per cut.	3 in.	9c. per cut.
2¼ and 2½ in.	6c. per cut.	3¼ to 4 in.	10c. per cut.

ELECTRICAL SUPPLIES

ARMORED CABLE—Price per 1,000 ft.—5 per cent. 10 days.

B. & S. Size	Two Cond. M. Ft.	Three Cond. M. Ft.	Two Cond. Lead M. Ft.	Three Cond. Lead M. Ft.
No. 14 solid	$29.00 (net)	$40.00 (net)	$180.00	$220.00
No. 12 solid	136.00	180.00	225.00	275.00
No. 10 solid	185.00	235.00	275.00	325.00
No. 8 stranded	305.00	375.00	420.00	500.00
No. 6 stranded	440.00	530.00	615.00	.....

From the above lists discounts are:		Lead Covered
Less than coil lots	50%	30%
Coils to 1,000 ft.	60%	35%
1,000 to 5,000 ft.	65%	38%
5,000 ft. and over	67%	40%

CONDUIT—Price per 1,000 ft.; **ELBOWS AND COUPLINGS,** per 100 pieces, extra f.o.b. New York warehouse. Discount of 5 per cent. for payment in 10 days. No delivery charges, regardless of quantity.

Size In.	Conduit Black Per M	Conduit Galvanized Per M	Elbows Black Per C	Elbows Galvanized Per C	Couplings Black Per C	Couplings Galvanized Per C
¼	$56.50	$61.34	$7.76	$8.83	$4.52	$4.92
⅜	72.07	78.63	10.21	11.63	6.46	7.03
1	103.31	113.00	15.10	17.21	8.39	9.13
1¼	139.77	152.88	20.51	23.07	11.78	12.75
1½	167.12	182.79	27.34	30.76	14.56	15.75
2	224.85	245.94	50.13	56.40	19.41	21.01
2½	355.50	388.85	82.03	92.28	27.73	30.01
3	464.88	508.50	218.74	246.10	41.59	45.01
3½	585.30	637.74	483.04	543.46	55.46	60.02
4	714.17	776.30	558.23	628.06	69.32	75.02

CONDUIT BODIES AND FITTINGS—Black or galvanized.

	Less Than $10 List	$10 List to $100	$100 List and Over
Standard package	10%	20%	28%
Less than standard package	5%	10%	20%

CUT-OUTS—Following are net prices, each, in standard-package quantities:

CUT-OUTS, PLUG, SOLID, NEUTRAL OR 2-FUSE

S. P. M. L.	$0.12	D. P. D. B.	$0.31
D. P. M. L.	.16	T. P. S. B.	.35
T. P. M. L.	.27	T. P. D. B.	.47
D. P. S. B.	.16		

CUT-OUTS, N. E. C. FUSE, SOLID, NEUTRAL OR 2-FUSE

	0-30 Amp.	31-60 Amp.	60-100 Amp.
D. P. M. L.	$0.27	$0.70	$1.75
T. P. M. L.	.40	1.00	2.30
D. P. S. B.	.35	.87	.....
T. P. S. B.	.67	1.50	.....
D. P. D. B.	.65	1.75	.....
T. P. D. B.	1.12	3.00	.....
T. P. to D. P. D. B.	.75	2.10	.....

FLEXIBLE CORD—Price per 1,000 ft. in coils of 250 ft.:

No. 18 cotton reinforced heavy		$21.50
No. 16 cotton reinforced heavy		25.00
No. 18 cotton reinforced light		15.50
No. 16 cotton reinforced light		22.00
No. 18 cotton Canvasite cord		17.00
No. 16 cott n Canvasite cord		27.00
No. 16 super service cord or similar (2 wire) in 1,000 ft.	$70.80	*76.70
No. 14 super service cord or similar (2 wire) in 1,000 ft.	106.20	*115.05

*Less than 1,000 ft.

NATIONAL ELECTRIC CODE FUSES, NON-REFILLABLE—

250-Volt	Std. Pkg.	List	600-Volt	Std. Pkg.	List
3-amp. to 30-amp.,	100	$0.15	3-amp. to 30-amp.,	100	$0.30
35-amp. to 60-amp.,	100	.30	35-amp. to 60-amp.,	100	.60
61-amp. to 100-amp.,	50	.90	65-amp. to 100-amp.,	50	1.50
101-amp. to 200-amp.,	25	2.00	110-amp. to 200-amp.,	25	2.50
201-amp. to 400-amp.,	25	3.60	225-amp. to 400-amp.,	25	5.50
401-amp. to 600-amp.,	10	5.50	450-amp. to 600-amp.,	10	8.00

Discount: Less than one-fifth standard package, 60%; one-fifth to standard package, 65%; standard package, 70%.

RENEWABLE FUSES—List price each:

Sizes	250-Volt List-Price	600-Volt List-Price	Std. Pkg. Quantity	Carton Quantity
1 to 30-amp.	$0.50	$1.10	100	10
35 to 60-amp.	1.00	1.25	100	10
65 to 100-amp.	2.00	3.00	50	5
110 to 200-amp.	4.00	5.00	25	5
225 to 400-amp.	7.50	11.00	25	1
450 to 600-amp.	11.00	16.00	10	1

REFILLS—

1 to 30-amp.	$0.03 ea.	$0.05	100	100
35 to 60-amp.	.05 ea.	.06	100	100
65 to 100-amp.	.10 ea.	.10	50	50
110 to 200-amp.	.15 ea.	.15	25	50
225 to 400-amp.	.30 ea.	.30	25	25
450 to 600-amp.	.60 ea.	.60	10	10

Discount Without Contract—Fuses:	
Broken cartons	Net list
Unbroken cartons	17%
Ten unbroken cartons	34%
Discount Without Contract—Renewals:	
Broken cartons	Net list
Unbroken cartons	17%
Ten unbroken cartons	34%
Discount With Contract—Fuses:	
Broken cartons	5%
Unbroken cartons	20%
Ten unbroken cartons	36%
Discount With Contract—Renewals:	
Broken cartons	Net list
Ten unbroken cartons	36%

Carton quantities may be combined to obtain maximum discounts.

FUSE PLUGS, MICA CAP—

0–30 ampere, standard package (500)	$2.80
0–30 ampere, less than standard package	3.10

LAMPS—Below are present quotations in less than standard package quantities on Mazda standard, A type bulbs:

100—130 Volt Watts	General Type	Price Each	200—260 Volt Watts	Special Type	Price Each
15	A 17	$0.20	25	A 19	$0.25
25	A 19	.20	50	A 21	.25
40	A 21	.20	100	A 23	.45
50	A 21	.20	...	....	.....
60	A 21	.20	...	....	.....
100	A 23	.35	...	....	.....

Standard pkg. quantities are subject to discount of 10% from list. Annual contracts ranging from $75 to $300,000 net, allow a discount of 15 to 40% from list.

PLUGS, ATTACHMENT—

	Each
Porcelain, separable, attachment plug	$0.18
Composition, 2-piece, attachment plug	.27
Swivel attachment plug	.12
Small size, 2-piece plug, composition	.07

RUBBER-COVERED COPPER WIRE—Per 1000 ft. f.o.b. New York:

No.	Solid Single Braid	Solid Double Braid	Stranded, Double Braid	Solid Duplex
14	$7.20	$9.90	$12.30	$20.50
12	10.90	12.69	15.50	27.00
10	14.85	16.85	20.40	36.15
8	22.05	24.80	27.10	51.00
6	.....	.....	39.50	.....
4	.....	.....	57.00	.....
2	.....	.....	79.50	.....
1	.....	.....	107.00	.....
0	.....	.....	132.00	.....
00	.....	.....	158.00	.....
000	.....	.....	193.00	.....
0000	.....	.....	235.00	.....

SOCKETS, BRASS SHELL—Price each, net:

	¼ In. or Pendant Cap Key	¼ In. or Pendant Cap Keyless	¼ In. or Pendant Cap Pull	⅜ In. Cap Key	⅜ In. Cap Keyless	⅜ In. Cap Pull
Standard package	$0.12	$0.10	$0.16	$0.16½	$0.14	$0.20
Unbroken carton	.14	.12	.18	.18	.16	.21
Broken carton	.16	.14	.20	.20	.18	.24

WIRING SUPPLIES—

Friction tape, ¾ in., in less than 100 lb., 31c. per lb.; in 100 lb. lots, 29c. per lb
Rubber tape, ¾ in., in less than 100 lb., 33c. per lb.; in 100 lb. lots, 31c. per lb.
Wire solder, in less than 100 lb., 33c. per lb.; in 100 lb. lots, 31c. per lb.
Soldering paste, 2 oz. cans ..... $1.10 doz.

ENCLOSED SWITCHES, KNIFE—Safety type, externally operated, 250 d.c. or a.c., N.E.C.

TYPE "C" FUSED BOTTOM

Size, Amp.	Double Pole, Each	Three Pole, Each	Four Pole Each
30	$4.50	$6.00	$7.25
60	7.50	8.25	10.50
100	10.50	13.00	22.50
200	16.00	20.00	36.00

Discounts:	
Less than $25.00 list value	30%
$25.00 to $50.00 list value	35%
$50.00 list value or over	40%